DESIGN AND CONSTRUCTION NUMBER

ELECTRICAL WORLD

OCTOBER 3, 1931
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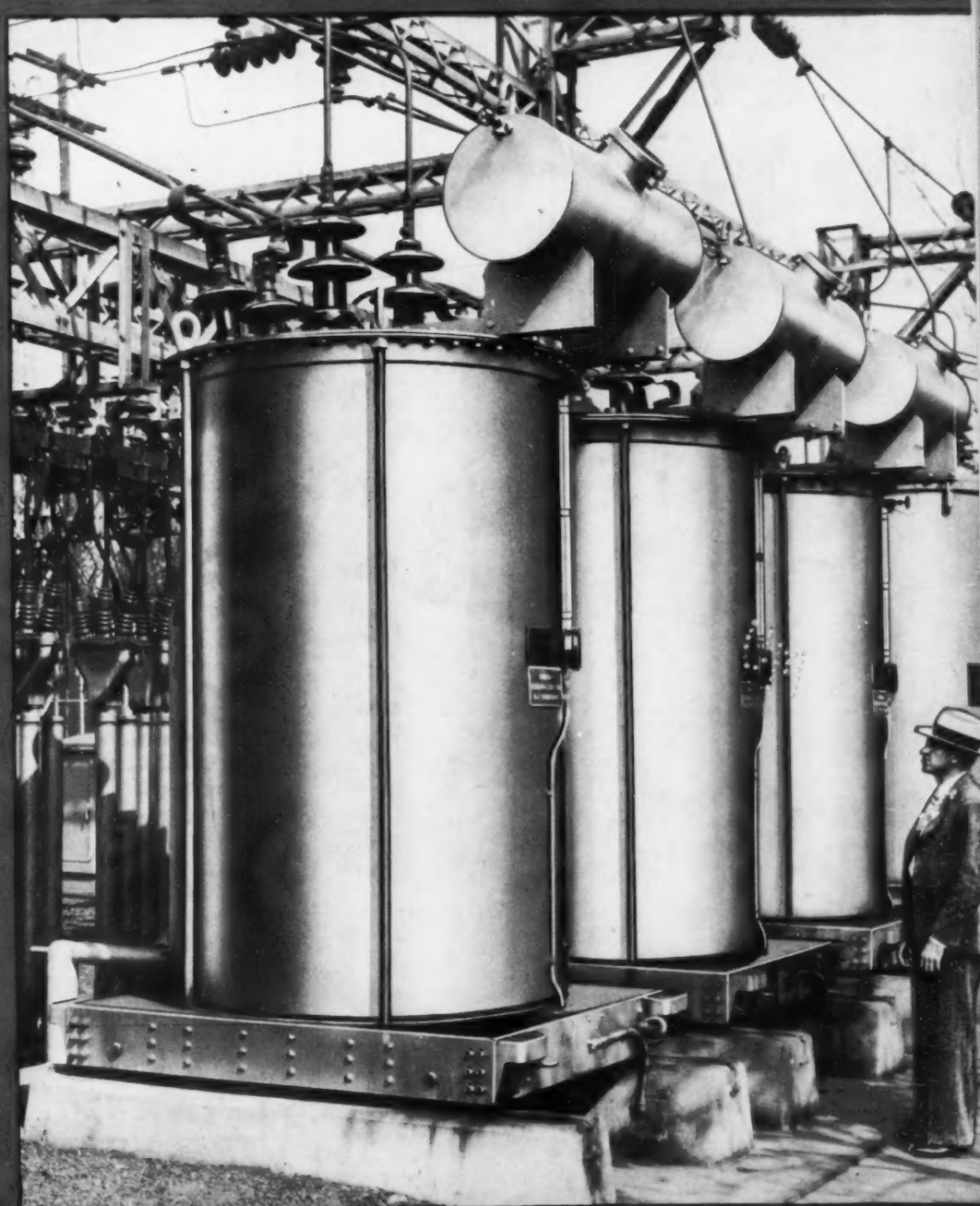

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LOW LOSSES LONG LIFE

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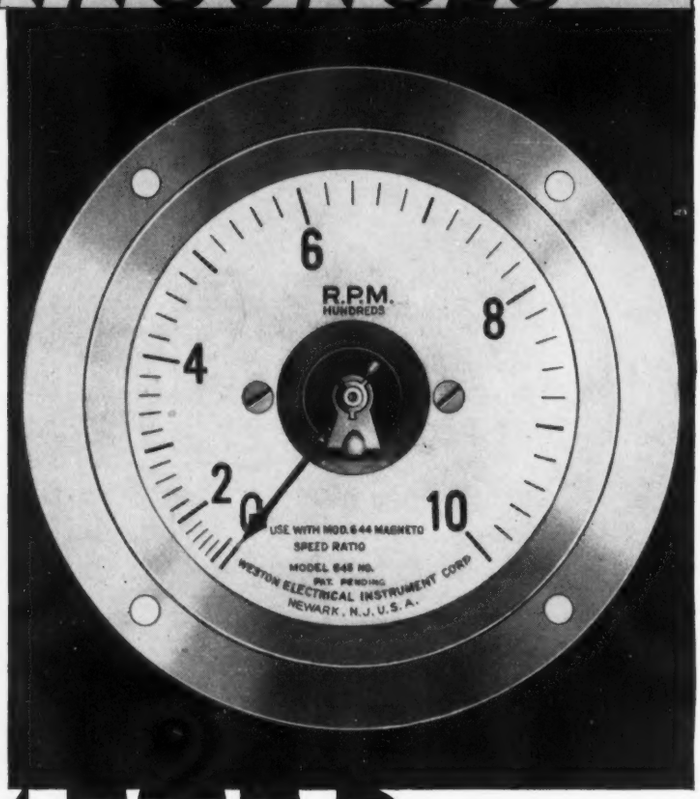
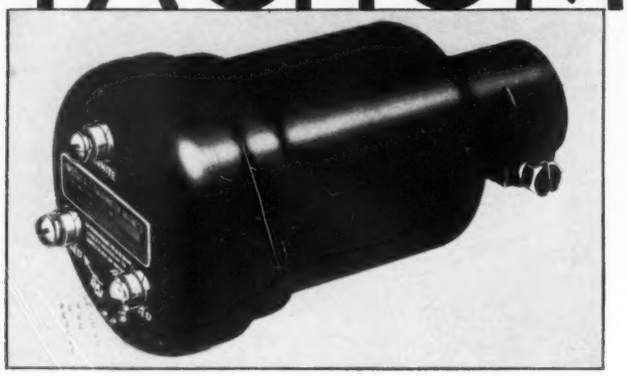


NEW ELECTRIC TACHOMETER



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OCTOBER 3, 1931

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ELECTRICAL WORLD

for the Week Ending

October 3, 1931

Design and construction practices in annual review

We cannot hope to re-establish any sound or lasting prosperity if we create in American business life a set of Robin Hoods to steal from one class in order to give alms to another.

RICHARD WHITNEY,
President
New York Stock Exchange.

—**Construction work may lag,** but there is no dearth of engineering ideas where it is in progress. Review of some outstanding practices shows economies and performance further improved.

—**A.C. network design advances** as standardization advantages are realized upon. Combined transformer and manhole vaults save excavation expense. Secondary bus replaces junction box—*p. 584.*

Opinions differ on wooden insulation

—**Value of wooden insulation** is highly undetermined by replies of operators to questions on performance characteristics. Many variables prevent valid generalizations—*p. 605.*

—**Modern industrial lighting** practices show wide ranges of intensities in various industries and divisions, but general level continues to rise where production is studied—*p. 616.*

Power engineers evaluate trends

—**Prominent engineers answer** some pertinent queries regarding present trends in steam station practice, and the agreement of the replies indicates the art to be approaching standardization—*p. 588.*

—**Electric welding in the field** speeds pipe-line production, bringing advantages realized in shop-work and some distinctive ones all its own to outside fabricating jobs of various diameters—*p. 600.*

Utilities consider power from air

—**Faraday centennial is closed** after more than a week of observance. Elihu Thomson in England and F. B. Jewett by telephone from America address the British celebrants in tribute to the foundation layer of today's electrical world—*p. 576.*

—**Six companies finance trial** of rotor-ship principle for generation of electricity from the wind. A new era in power production or a wild idea? Erratic nature of air currents a serious obstacle, as are mechanical features—*p. 574.*

Six Large Light and Power Companies Back Experimental Wind-Rotor Plant

FULL-SCALE experimentation is about to be undertaken to ascertain the extent to which electric power can be produced economically through the medium of a wind rotor similar in principle of action to that of Dr. Floettner's rotor ship which crossed the Atlantic from Germany several years ago. Six prominent utility companies are sponsoring the trial installation on an exposed plot adjoining the West Burlington (N. J.) station of the Public Service Electric & Gas Company. This utility is one of the participants, the others being the Middle West Utilities, Detroit Edison, Standard Gas & Electric, United Gas Improvement and United Light & Power companies.

The present conception of a power plant founded on this principle envisages between 15 and 40 50-ton vertical rotors mounted on trucks which circle around a 30-ft.-gage track about 3,000 ft. in diameter. Each rotor consists of an aluminum shell braced and supported by a duralumin framework. The rotating system is given its initial rotation by means of a motor. The wind then propels it around the track and drives a generator coupled to the rotor, and at the same time gearing maintains the requisite rotation of each cylinder about its axis. The generators are operated in parallel, feeding their output through trolleys to an overhead bus. In order to provide for continuous power and therefore continuous rotation it will be necessary to reverse the direction of rotation of each rotor twice during a complete circuit of the track, otherwise the torques produced on opposite semicircles would neutralize each other. Each rotor unit is expected to be capable of producing 1,000 kw. under the most favorable wind velocities.

At West Burlington a full-sized rotor is to be erected on stationary foundations for the purpose of confirming the results obtained in wind-tunnel tests on a small working model. As an incident in the determination of the probable useful output, the experiment is intended to throw light on the means that will have to be developed for reversing rotor directions and maintaining constant speed and frequency, the limits of wind velocity for which the operation would be feasible, the probable number of hours of operation per year and the cost of a commercial assembly. It is now estimated that the plant would cost about $40 per kilowatt for a 40,000-kw. installation.

United Engineers & Constructors, Inc., will erect the trial equipment, with I. P. Morris & De La Vergne, Inc., and the Baldwin Locomotive Works participating in the production of the apparatus. The scheme is the invention of Julius D. Madaras, who is president of the Madaras Rotor Power Company of Detroit. C. F. Hirshfeld, director of research of the Detroit Edison Company, is secretary of the company.

▼

Edison's Health Still Far from Satisfactory

A BULLETIN ISSUED this week by Dr. Hubert S. Howe, Thomas A. Edison's physician, spoke of the inventor seeming slightly weaker, and the effect of this discouraging report was not removed by the quoted comments of Mr. Edison's sons, who admitted that their father had seemed to lose some of the interest in the day's doings that has always characterized him. On three occasions early this week he omitted the automobile ride which he had been taking almost daily. That this failure to maintain the progress he had made toward recovery from the ill health that has beset him since his return from Florida to his New Jersey home several months ago will prove only a passing phase is the reasoned hope of those who are familiar with the physical stamina the veteran has all his life shown and which until recently was proof against advancing years.

▼

CHIMES RING ELECTRICALLY

Solenoids rated at 110 volts, 50 cycles, actuate the hammers that play recently installed pipes of this kind in two Los Angeles churches. Two single-pole, 75-amp. contactors control the solenoids and in turn are actuated from an organ keyboard on a 48-volt circuit. The control panel was built by the General Electric Company.

▼

Old Problems Freshly Met at Poland Spring

PRESSING PROBLEMS in public and trade relations occupied the annual convention of the New England Division, N.E.L.A., held this week at Poland Spring, Me. Stirring addresses were made by National President J. F. Owens, Managing Director Paul S. Clapp and Vice-President Harry Reid. Self-criticism as a means of improving industry practices, hospitality to suggestions of other branches of the industry for better trade relations and fair competition, education of employees to strengthen public contacts, elimination of misunderstandings in the retail field and organized handling of rural service problems were outstanding topics.

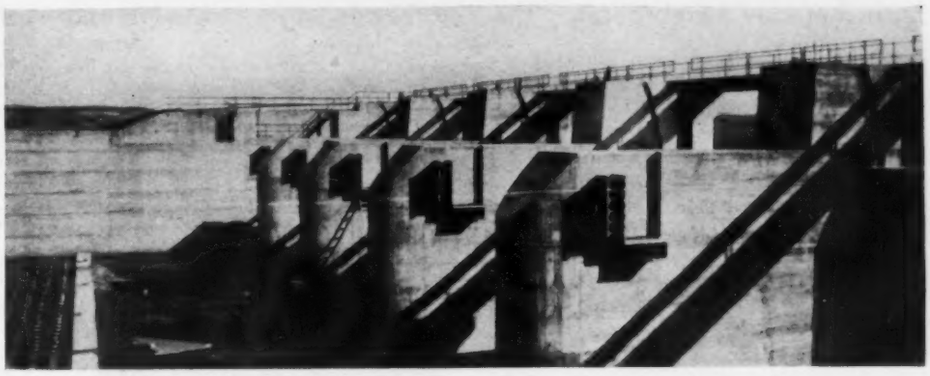
L. W. W. Morrow, editor ELECTRICAL WORLD, presented an analysis of electrical merchandising volume distribution and costs in a city of 120,000 population, emphasizing the value of multiple outlets, sound business management and profitable co-operation in the cultivation of the electrical market in all its ramifications.

President Owens stressed the need of employee training and friendly public relations to offset subversive socialistic propaganda aimed at the overturning of American institutions, and Mr. Reid advocated economic team play for regional upbuilding along the lines followed by the New England Council, designating this as "Yankee communism"—an answer to proposals embodying governmental interference with the development and progress of the industry.

F. L. Rimbach advocated placing rural-service problems in the hands of qualified specialists in every important company, showing the excellent co-operative results obtained in New England in the past two years by the power companies, farming, educational and

POWER-COMPANY SPILLWAY NEAR DALLAS AWAITING MOUNTAIN CREEK WATER

Litigation is holding back the coming 25,000-kva. Mountain Creek plant of the Dallas Power & Light Company, but an earthen dam 2 miles in length, with concrete spillway, is ready. From the lake to be created cooling water will be derived. The accompanying photo was snapped for the ELECTRICAL WORLD.



governmental interests concerned with agricultural prosperity.

W. C. Bell, president-elect of the New England Division, advocated close study of trade relations, better acquaintance with electrical dealers, correction of causes of trade friction, emphasis upon energy consumption as a measure of appliance sales value and constructive leadership in utility co-operation.

On Tuesday A. H. Kehoe, chairman Engineering National Section, spoke of the importance of studying electrical distribution economies and related system planning. C. T. Sinclair cited the excellent results obtained in the operation of Pittsburgh's 4,000-volt primary network, and W. T. Ackerman led an extended discussion of rural electrification problems.

The convention program also included a women's session Tuesday evening and accounting and public relations sessions Wednesday, the latter including addresses by Frank E. Watts and Philip Cabot.

Transfer of Westinghouse Lighting Institute

ACQUISITION on October 1 by the Electrical Association of New York of the Westinghouse Lighting Institute in Grand Central Palace, that city, was announced on Wednesday by the Westinghouse Lamp Company and the new possessor. The transfer was made possible by the generosity of the Westinghouse Lamp Company, which offered to contribute the institute, without cost, to help carry forward the co-operative industry program of the association. To Clarence L. Law, president of the Electrical Association, who is also general commercial manager of the New York Edison Company, initiation of the plan is due. Mr. Law, in announcing the transfer, said:

"Opportunities for broad educational and market development accomplishments through co-ordination of effort by every branch of the industry are perhaps more numerous now than ever before. If they are to be properly capitalized, it is mandatory that the industry as a whole undertake the task co-operatively. This the Electrical Association of New York is determined to do and with that in mind is venturing upon a comprehensive program that will include educational, market development and sales activities in which every element of the membership can participate. The nucleus for these activities will be the association's Electrical Institute."

Arthur E. Allen, vice-president and general manager of the Westinghouse Lamp Company, with whom Mr. Law negotiated the transfer, said:

"The prevailing trend of co-operative rather than individual sponsorship of broad industry promotional activities has actuated our decision to contribute our institute without cost to the Electrical Association of New York. Its plans should materially broaden the scope of the institute's influence, and we contemplate with pardonable pride the continued growth and usefulness of this firmly established institution."

Ralph Neumuller, former director of the Westinghouse Lighting Institute, will assume the managing directorship of the association, supervising both its market development and its Electrical Institute activities.

I. E. S. Silver Anniversary This Month at Pittsburgh

AGAIN WILL THE Illuminating Engineering Society hold a "pre-convention session" when it assembles at Pittsburgh in the middle of October for its twenty-fifth annual convention. This pre-convention will take place on Monday, October 12, and will be of special interest to central-station lighting.

A general session on Tuesday morning will be followed by an architectural lighting session in the afternoon and an aviation lighting session on the following morning. On Wednesday evening, at a silver anniversary service, Dr. Elihu Thomson and Prof. André Blondel of Paris will be made honorary members. L. A. Hawkins will speak.

Thursday morning there will be a lighting service session, and on Thursday afternoon and Friday morning lighting practice sessions will be held. Synthetic light, atmospheric lighting, the window as a light source, ultraviolet lamps, variations of intensities, lighting in building codes, school lighting, street lighting, department-store lighting and the lighting of the Welland Ship Canal will be the subjects of papers, and G. H. Stickney will give a résumé of the International Congress on Illumination just held in Great Britain.

Annual Lighting Design Prizes from I.E.S. Fund

SIMULTANEOUS ANNOUNCEMENT is made by the Illuminating Engineering Society, the Beaux Arts Institute of Design and the American Institute of Architects that the first-named association will provide annual prizes totaling $1,500 by means of a fund to be administered for it by the Institute of Architects. Competitions will be under the direction of the Beaux Arts Institute, which will include a problem in illumination in the yearly contests it sponsors. This problem may concern the lighting of an exposition, a theater, a railway station, a retail store or simply of a home. The I.E.S. will select a committee of four leading members to work with the educational committee of the Beaux Arts Institute, and a joint committee of architects and illuminating engineers will select the problems. The jury of award will comprise the I.E.S. committee and prominent architects.

Americans Participate in Faraday Celebration

SEATED AT A DESK in the Boston office of the American Telephone & Telegraph Company at 100 Milk Street, Frank B. Jewett, vice-president American Telephone & Telegraph Company, at noon on Wednesday, September 23, made an address over the transatlantic telephone to scientists assembled in Albert Hall, London, for the opening of the Michael Faraday exhibition, which followed receptions to delegates and commemorative meetings on Monday and Tuesday.

Dr. Jewett extended the greetings of 22 American electrical and scientific societies, many of which were also represented in London by delegates.

"For me to sit here in Boston," Dr. Jewett said, "where Alexander Graham Bell made his great invention based on Faraday's discoveries, and address you in London requires the application of something of all that men have learned in a hundred years in the fields to which Faraday opened the gates. Looking back across the years from the vantage point of our present achievements, it seems incredible that such vast things could have had such modest beginnings as those simple experiments of a simple, kindly man. And yet, as we look forward through the eyes of a faith that has been trained to see distant things, it is clear that we have but embarked on the voyage."

An address delivered in London by Elihu Thomson before the British Association for the Advancement of Science was another notable transatlantic contribution to the celebration. Professor Thomson told the British scientists how he was in his youth inspired by seeing the early English dynamos that grew out of Faraday's discoveries and described the founding of the Thomson-Houston Electric Company in America.

Others who took part at one or another of the various gatherings during the celebration were Prime Minister MacDonald, Sir William Bragg, Signor Marconi, Clifford C. Patterson, Sir Josiah Stamp, Sir Oliver Lodge and General J. C. Smuts.

At the Faraday Centenary Exposition in London all the branches of research in which the great scientist took part were represented—electricity, chemistry, metallurgy. Personal effects filled the inner circle of three concentric rings in which the exhibit was arranged. In the next ring were illustrated the stages of development reached in later years by Faraday. There were not only pieces of laboratory equipment used by him, but some of the products. They led naturally outward to the third ring, where the products of modern science marked for the moment the end of the road which Faraday opened.

The original semi-basement workshop of Faraday, poorly lighted by an inadequate skylight and a candle, was reproduced. It afforded an effective contrast to the rest of the exposition and a vivid commentary on the man and his methods. Liverpool also held a Faraday exposition.

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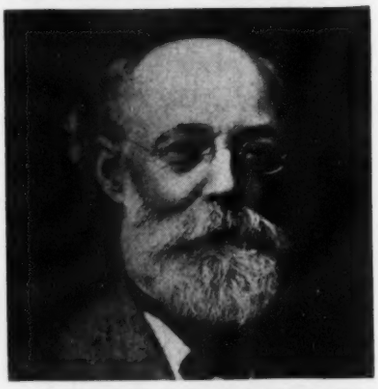
KANSAS CITY'S VETERANS



Top—Joseph F. Porter, president Kansas City Power & Light Company.
Center—Edwin R. Weeks, first of the vice-presidents and second of the presidents of the N.E.L.A. He installed an Edison bipolar dynamo in Kansas City's first central station in the early eighties.
Bottom—William M. Hand, now Kansas City manager for the General Electric Company.

Among participants at the Southwest Power Conference recently held in Kansas City none received heartier greetings than the three Edison Pioneers of that city.

Standard Gas "Write-Up" Probably Under 4 per Cent

TESTIMONY OFFERED the Federal Trade Commission at the reopening of its utility investigation on Tuesday revealed that in the nineteen years of the existence of the Standard Gas & Electric Company there was a write-up of probably not more than 3.3 per cent of the book value of investments held by the company on December 31, 1929, and at the very most, using the unrevised estimates of investment, of 5.83 per cent.

Testimony by Dr. Thomas W. Mitchell, commission examiner, showed that Standard Gas and its subsidiaries had total assets on December 31, 1929, of $1,090,000,000. Assets of the holding company itself on that date were $191,000,000, of which approximately $163,000,000 was securities owned.

▼

St. Lawrence Hearings Postponed Till November

PUBLIC HEARINGS on data received from electrical companies will begin the first Monday in November instead of on October 1, as at first planned, Frank P. Walsh, chairman of the Power Authority of the State of New York, announces. The hearings are to be conducted by the Power Authority on replies to its questionnaire as a basis for arriving at fair terms for the contracts to be negotiated with private companies for St. Lawrence power.

▼

Potomac Electric Power Will Appeal to Courts

NOTIFICATION WAS GIVEN to the Public Utilities Commission of the District of Columbia last week by the Potomac Electric Power Company that an appeal to the courts will be taken to prevent the commission from changing the basis on which the company's rates have been fixed since 1925 and by which any excess earnings over 7½ per cent have been divided fifty-fifty between the customers and the utility, the customers' half being applied to the rates for the succeeding year.

Under this mutual arrangement—approved by the District of Columbia courts—residents of Washington have enjoyed one of the lowest rates in the country. The company declares that an order from the commission notifying it that rates will be fixed for next year regardless of the consent decree violates its rights. The commission's order was based on belief that the company's actual earnings exceed 10 per cent.

Bagnell Gives Theme for A. I. E. E. at Kansas City

AN EVENING SESSION on Thursday, October 22, will be devoted to the St. Louis interconnection with the new Bagnell hydro-electric plant of the Union Electric Light & Power Company when the Southwest regional meeting of the American Institute of Electrical Engineers is held at Kansas City. E. L. Hough and L. V. Nelson will discuss the tying in of the 25-cycle and 60-cycle systems, E. K. Shively and G. S. Whitlow automatic control for variable-ratio frequency converters, and there will be a motion picture showing the construction of the dam.

Altogether nineteen papers will be presented at four technical sessions, the other three being filled as follows:

Thursday Afternoon.—Selected Subjects: "Electric Arc Welding in Building Construction," P. N. Vinther, Dallas; "Effect of Wave Form on the Operation of Induction-Type Relays," P. H. Robinson, Houston; "Telegraphic Pilot-Wire Relay System," C. H. Frier, Oklahoma; "Calculating Load Division in Distribution Systems," C. T. Almquist, Oklahoma; "Backfires in Mercury-Arc Rectifiers," J. Slepian and L. R. Ludwig, Westinghouse; "Overvoltages on Transmission Systems Due to Dropping of Load," E. J. Burnham, General Electric.

Friday Morning. — Communication: "Forecasting Population for Engineering Purposes." J. N. Holsen; "Advance Planning of Long-Distance Telephone Facilities," O. C. McFarland; "Tape-Armored Telephone Toll Cable," C. W. Nystrom; "Time Factor in Telephone Transmission," O. B. Blackwell.

Saturday Morning.—Transmission and Distribution; "Field Investigation of Lightning Disturbances on Transmission Lines," D. C. Jackson, Jr., and R. W. Warner, Kansas; "Impulse-Voltage Tests on a 4,800-Volt Distribution Substation," H. W. Collins and E. E. Piepho, Detroit, and J. J. Torok, Westinghouse; "Corona Energy Loss," W. D. Weidlein; "Application of Primary Distribution Fuses," F. E. Sanford, Union Gas & Electric; "The Expulsion Fuse," J. Slepian and C. L. Denault, Westinghouse; "Fuse Cut-outs with Special Reference to Their Design and Application for A.-C. Distribution Circuits," E. G. Newton, General Electric.

There will be a banquet and entertainment on Friday evening.

▼

More Information Sought by Federal Power Board

CHAIRMEN OF THE regulatory commissions of the various states have received from Claude L. Draper, member of the Federal Power Commission, a letter in which, after citing the rules and regulations governing the administration of the federal water-power act in the matter of accounting, he requests answers to the following questions:

1. Is it the practice of your commission to require privately owned electric companies engaged in public service to keep their accounts in accordance with the National Association of Railroad and Utilities Commissioners' uniform classification of accounts?

If the answer to the above question is in the negative, please state in detail the system required and supply a copy of the form or forms used.

2. Is it the practice of your commission to require privately owned electric companies engaged in public service to file annual reports upon forms prescribed by you?

If the answer to the above question is in the affirmative, please furnish a copy of the form or forms upon which said annual report is made.

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Merchandising Committee Records Good Progress

AT A MEETING of the Electrical Merchandising Joint Committee in New York recently a principal topic of discussion was the "Statement of Merchandising Procedure" adopted by all of the groups represented on the committee, including utility, dry goods, hardware, furniture and department-store men. Much satisfaction was expressed at the success of the local utilities in their efforts to initiate conferences with retailers for the settlement of vexing questions, and rapidly increasing results are expected in the near future. These activities are not confined to any particular part of the country. About 50 conferences have been held, and many more are in process of being organized.

How to determine the character of merchandise offered to retail merchants for resale received much attention in an effort to arrive at standards of reliability and safety. Another point taken up was the so-called "pioneering" of appliances. This has been conducted principally by the utilities in the past, but conditions have changed and readjustments may be desirable to determine when and where pioneering becomes ordinary merchandising.

Clause 5 of the "statement" relates to the use of premiums and "trade-ins," which have been much abused as a means for inducing sales. Both of them were deprecated, if not actually condemned, by the committee. They are regarded increasingly as a means of price-cutting to aid incompetent salespeople.

Representatives of electrical manufacturers discussed informally the "statement" as it bears upon their sales methods. Many differences in practice were disclosed, but there was a general agreement that any settlement of vexing questions would benefit the manufacturers equally with those who are engaged in selling their appliances. Hence they welcomed the opportunity of discussing these questions with the committee. Considerable opposition to some recent sales campaigns was expressed, but it was explained that these were planned and put into effect before the adoption of the "Statement of Merchandising Procedure."

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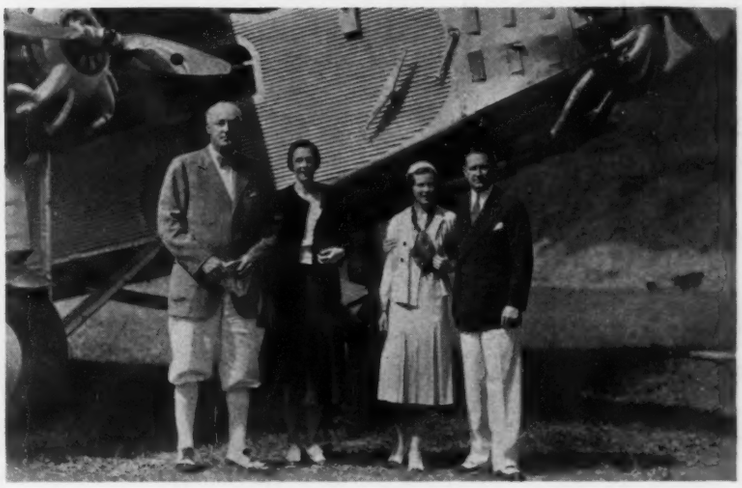
Missouri Utilities Adopt Merchandising Principles

SUBSCRIBING "WHOLEHEARTEDLY" to the "Statement of Merchandising Procedure" adopted by the Electrical Merchandising Joint Committee at Atlantic City last June (ELECTRICAL WORLD, July 11, page 50), the executive committee of the Missouri Association of

LIGHT AND POWER EXECUTIVES TAKE TO FLYING



Navigation of the air steadily gains in popularity both as a time saver in travel and a recreation during "time off." The photograph shows (left) Louis H. Egan, president Union Electric Light & Power Company, St. Louis, and Matthew S. Sloan, president New York Edison Company, each accompanied by a daughter, at the White Sulphur Springs (W. Va.) convention of the Association of Edison Illuminating Companies last week.

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PERSISTENTLY NAVIES AND ARMIES SEARCH THE HORIZON AND THE HEAVENS

—*Wide World Photos*

—*Keystone View Co.*

On the left the British Atlantic fleet, anchored at Torquay, pleases crowds of holiday makers by a searchlight display. More grim in significance is the scene on the right, where the United States Army's anti-aircraft exercises at Fort Humphreys, Va., are shown in full blast.

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Public Utilities has passed the following resolution in support thereof:

Resolved, that the weight of evidence clearly shows that where the utility promotes and sells gas and electric consuming appliances with due regard to sound merchandising principles and trade ethics the best interests of the public, the merchants and the utilities are served, and on this promise the executive committee of the Missouri Association of Public Utilities recommends that member companies promptly make contact with merchants in the territory served by them, lay frankly before them the facts as they are known and the policies they pursue, and that the merchants be offered by the utilities a full measure of sound co-operation in the merchandising field, to the end that a full and harmonious merchandising job may be done to the best interest of all concerned.

The resolution has been sent to all electric and gas utilities in Missouri with the recommendation that they review their merchandising policies and bring them into line with these principles.

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Trade Commission Refers to Bond & Share Suit

IN A REPORT issued last week by the Federal Trade Commission, giving a résumé of the status of various cases now before it, reference was made to the long delay in the appointment of a master by the United States District Court for Southern New York to determine whether or not the court was right in assuming that the Electric Bond & Share Company was, "in part at least, engaged in interstate commerce." Both the company named and the Federal Trade Commission, whose action to compel the company to answer certain questions and produce certain records led to the court's pronouncement, agreed to the appointment of the master, but this has not been done in the 26 months that have since elapsed. The commission now says:

"The parties have been engaged in getting up an agreed statement of the facts. The prospects for an early agreement are good, but the matter has been delayed because of the demands on the time of the commission counsel and examiners in connection with other hearings under this same resolution and because counsel for the company was abroad. It is hoped that the matter can again be brought on for hearing at an early date."

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Scattered Happenings in the Electrical Sphere

UNITED STATES

Safe Harbor Power This Year?

December 31 is now mentioned as the date set for the receipt of power at Baltimore from the Pennsylvania Water & Power Company's new Safe Harbor dam on the Susquehanna River.

Aluminum Busbars for Roseland, N. J.

Engineers of the Public Service Electric & Gas Company of New Jersey have specified aluminum instead of copper for the 220-kv. busbars at Roseland switching station. These aluminum buses are in the shape of tubes 5 in. in diameter and are said to be the first busbars of their type to be installed by any electric company in the United States. They are installed in the open as part of the triple interconnection of the Public Service, Philadelphia Electric and Pennsylvania Power & Light companies. Their utilization made possible a simplification of design and of the work of installation.

Colorado Commission's Rural Policy

An order recently issued by the Colorado Public Utilities Commission forbids power companies to assess all or part of the cost of rural extensions on new customers. The company must file with the commission a statement of the terms under which service will be given when the estimated revenue seems to justify the construction expense. If the revenue would be inadequate, an additional guarantee from the customer may be required, but in no case can the payments be expanded over five years. Service is not to be refused because the new customer is unable at the moment to finance his part.

Boston & Maine Air Conditioning

A new system for conditioning the air on passenger cars has been tried successfully by the Boston & Maine Railroad. In contrast with the Baltimore & Ohio's gasoline-engine-driven apparatus (previously referred to in the ELECTRICAL WORLD), ice is to be carried in bunkers beneath each coach and iced water circulated by a 2-hp. motor installation. The designer, the R. B. Engineering Corporation, New York, says that temperatures can be increased or decreased over a wide range at the rate of 1 deg. F. a minute.

Licenses on Current River Asked

The Current River Power Company of Kansas City, Mo., has applied to the Federal Power Commission for permits to construct hydro-electric dams on the Current River at Blair's Creek, Mill Creek and Hargue Eddy. The Doniphan Hydro-Electric Company has an application pending for a permit to construct a power dam on the Current River north of Doniphan, Mo. The

Black River Hydro-Electric Company of Poplar Bluff, Mo., contemplates the construction of a hydro-electric dam on the Black River above Leeper, Mo.

French Electrical Men Make Tour

Eleven men closely connected with the electric power industry of France and headed by C. G. Malegarie, president of the Compagnie Parisienne de Distribution d'Electricité, are completing a tour of part of the United States, following one in eastern Canada. Their itinerary in this country has included Buffalo, Schenectady, Albany, New York, Philadelphia, Baltimore (with trips to Holtwood and Safe Harbor), Washington, Pittsburgh, Cleveland, Detroit, Chicago and St. Louis, and some of the party will go on to the Pacific Coast to view the hydro-electric developments there.

Another Columbia River Project

Application for a preliminary permit providing for a 350,000-hp. hydro project on the Columbia River in Washington and Oregon has been submitted to the Federal Power Commission by a group of New York men headed by Charles O. Lentz and Magnus Hellstrom. Plans call for a power plant at Cascade Locks in Skamania County, Wash., and Hood River County, Ore.

Reduced Rates for Large Customers

A schedule of reduced electric lighting rates for Terre Haute, filed by the Public Service Company of Indiana, has been approved by the tariff department of the Indiana Public Service Commission. The reduction brings a saving of about $50,000 a year to customers using more than 150 kw.-hr. a month.

Atlanta Council Demands Lower Rates

Material reductions in electric rates are asked of the Georgia Power Company in a resolution passed by the Atlanta City Council, which bases the demand on the reduction in commodity prices, the decrease in general earnings and the increased gross revenue of the company for the first seven months of 1931 in comparison with 1930.

Oppose Cleveland City Plant Expansion

A lawsuit to enjoin the Board of Election from placing the proposed two-and-a-half-million-dollar municipal light plant expansion bond issue on the ballot November 3 has been filed by the Building Owners and Managers' Association of Cleveland. The suit contends that such an election would be illegal.

Little Rock Council Stands Firm

Although the Mayor of Little Rock, Ark., vetoed the resolution of the City Council to sell the city's disused electrical plant for $10,500, the Council repassed the measure over his veto by 12 to 6. A referendum election is likely to be held.

Second Osage Line Authorized

Authority has been granted to the Stone & Webster Engineering Corporation by the Union Electric Light & Power Company of St. Louis to design and construct a second 132-kv. transmission line to extend from the Osage hydro-electric development to St. Louis. The estimated cost is about $1,000,000.

Pittsburgh Has New "White Way"

What is declared to be one of the finest bits of street lighting in the United States was inaugurated on Fifth Avenue, Pittsburgh, last week. Before the president of the City Council turned the switch which started the new "white way" a dinner of celebration was held at the William Penn Hotel and addressed by President F. R. Phillips of the Duquesne Light Company and others who had part in bringing the improvement.

Doherty-Company Management Fees

Accountants for the Missouri Public Service Commission who have been working two years on an audit of the books of the Empire District Electric Company of Joplin have reported that in their opinion the payment of $395,759 by the company and its predecessors to Henry L. Doherty & Company as engineering fees was improper because not "limited to the actual cost of necessary services actually rendered." The accountants recommend the elimination of this item from capital and operating accounts, and also the elimination of a managerial fee totaling $60,800. Total valuation was put at $25,105,706.

Additional Plans for Keuka Plant

A further expansion in the Lamoka Power Corporation's unusual hydro-electric development at Keuka Lake, N. Y., involving an additional expenditure of around $500,000, is contemplated. This step involves construction of a power station on Seneca Lake. The Lamoka-Keuka development now under way is said to represent an expenditure of about $1,000,000 and the cost of the new link will be additional. The program was launched when the Tri-State Gas & Electric Corporation acquired a third interest in the project and a contract was drawn to supply natural gas from the Wayne field to supplement the hydro-electric power. The Seneca Lake plant, it is said, will add power equal to the expanded production in the Lamoka-Keuka development. A drop of 400 ft. in the water flow from Lamoka Lake to Little and Keuka Lakes is an important factor in the first stage. The plant on Seneca Lake, if it is built, will take water from Lake Keuka, thus reaping the advantage of a further 200-ft. drop.

Coming Meetings

International Association of Electrical Inspectors—Northwestern Section, Salem, Ore., Oct. 5-7. F. D. Weber, 414 Lumbermen's Bldg., Portland, Ore.

Association of Electragists International—Hot Springs, Ark., Oct. 5-8. L. W. Davis, 420 Lexington Ave., New York.

National Electric Light Association—Engineering National Section committee meetings, Starrett's Netherland Plaza, Cincinnati, Oct. 5-9. A. J. Marshall, 420 Lexington Ave., New York.

National Safety Congress—Chicago, Oct. 12-16. W. H. Cameron, 20 N. Wacker Drive, Chicago.

Illuminating Engineering Society—William Penn Hotel, Pittsburgh, Oct. 13-16. E. H. Hobbie, 29 W. 39th St., New York.

National Association of Railroad and Utilities Commissioners — Jefferson Hotel, Richmond, Va., Oct. 20-23. J. B. Walker, 270 Madison Ave., New York.

Wisconsin Utilities Association—Commercial Section, Oct. 22-23, Hotel Loraine, Madison; Electric Section, Hotel Pfisterer, Milwaukee, Nov. 12-13. J. N. Cadby, 135 W. Wells St., Milwaukee.

American Institute of Electrical Engineers—District meeting, Kansas City, Mo., Oct. 22-24. F. L. Hutchinson, 33 W. 39th St., New York.

National Electrical Wholesalers' Association—Starrett's Netherland Plaza, Cincinnati, Nov. 9-13. E. Donald Tolles, 165 Broadway, New York.

North Central Electric Association—Accounting Section, St. Paul Hotel, St. Paul, Nov. 13 and 14. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

International Conference on Bituminous Coal—Pittsburgh, Nov. 16-21. T. R. Alexander, Carnegie Institute of Technology, Pittsburgh.

CANADA

Manitoba Rates Reduced

The Manitoba government has announced substantial reductions in rates charged for electrical energy supplied by the provincial Hydro to 30 communities of the southern and western parts of the province. These reductions, applying to nearly all towns in the areas mentioned, total $13,812 on the basis of 1930 consumption, effective from the first of October. Consideration now is being given to reductions in rates to other communities.

Montreal Company Gets Verdun Plant

Responsibility for electrical service to Verdun's 65,000 citizens was assumed by Montreal Light, Heat & Power Consolidated last week when a check for $300,000 was handed to the Verdun authorities in payment for the distribution system. Previously the municipal plant had served customers in competition with the Montreal utility. The two systems are now to be amalgamated.

ABROAD

High-Pressure Turbine for Ford Factory

Steam pressure of 1,200 lb. will be used at a large factory being built for Henry Ford at Dagenham, England. Various fuels, including refuse, will be used under the boilers. The turbine, running at 3,000 r.p.m., will be coupled to a 34,400-kva. generator and a 3,570-kva. auxiliary generator.

Day and night excavation speeds at Beauharnois

Clearing dynamited rock from the tailrace of the Beauharnois Power Corporation's St. Lawrence River power house, well on the way to completion, this 9¼-cu.yd. Marion shovel works 24 hours a day. Motors totaling more than 675 hp. drive the equipment. Motor-generator sets perform the a.c.-d.c. conversion. This gargantuan construction aid makes light work of heavy and is representative of labor- and time-saving expedients employed on this Canadian project

EDITORIALS

L.W.W.MORROW
Editor

Trends in design and construction

TAKING a current perspective view, little change can be seen in design and construction in the several branches of the electrical industry. But if one looks back over the decade very decided progress is noted in nearly all applications. Electrical apparatus is better, cheaper and more reliable; assemblies of apparatus have been simplified and improved; standardization and simplification have been instrumental in reducing the number and types of equipments used, and invention has brought new equipment to commercial applications. Cost reductions, space savings, reduced labor charges and better and more standardized performance characterize all aspects of design and construction.

At the present time, aside from further standardization and simplification, possibly the outstanding trend is the use of the unit factory-built assembly idea in greater degree to replace the older practice of buying individual items of equipment and then assembling them in accord with individual ideas of installation merit. Each construction project is now looked upon, rather, as a unit assembly to perform a function, and the over-all objective is to get this function performed at a minimum of cost and with minimum operating complexity.

A house service, for example, is a unit assembly of several pieces of electrical equipment, and in large measure this assembly is built in a factory and shipped and installed as a unit. In an industrial heat-treating furnace the items are assembled as a unit to do a production job, and heating, control, ventilation and measuring devices necessary to the task are designed and installed as a part of a unit assembly. In some measure these ideas are being carried out in substations and power stations also, and the future promises their widespread development. The factory-built assembly has the advantage of standardization, quick serviceability upon installation, avoidance of large local labor and engineering charges and inherent possibilities of cost reductions for equipment.

In addition, it is notable that standardized design and construction are making great headway in both industrial and utility electrical applications. In the older days it seemed as if engineers took their greatest pride in designing something different from that existing, but through committee action and the dissemination of facts the present trend is to pick out the best current design and standardize upon this. Many engineering departments today have standard plans for all installations, with a consequent reduction in their costs and in national costs. Engineers now take pride in standardizing design and construction.

In the future these two trends appear to offer the major economic savings. Electrical equipment has reached an advanced stage of performance and quality, and no radical advancement can be visualized for the well-known devices such as motors, generators, meters and furnaces. Only through radical inventions will large replacements be made and new uses for electricity be found. Many such developments undoubtedly there will be, but the part of wisdom is to build present markets and improve present practices.

Liberalizing investment laws

ADVERSE factors in the railroad industry which are robbing many bond issues of their legality for savings-bank investment have brought the suggestion that investment laws relating to power utility bonds should be liberalized within reasonable limits. Many utility leaders are urging such a movement. Large institutional investors appear to favor it. It remains true that

a broadening process of this kind, desirable as it might be from some standpoints, would bring to the industry added responsibility. In view of the potential danger to the interests of bank depositors and policy holders in any provision for more latitude in investing trust funds, the utility industry is charged more than ever with the obligation of guarding against possible abuses.

The senior securities of electrical utilities today constitute an exceedingly high-grade investment medium. Stability and security are inherent features. It is essential that steps be taken by the industry to see that this stability be not jeopardized if and as present investment requirements are made less rigid. If there is a minority in the industry willing to overlook the old safeguards, to allow inadequate depreciation requirements to be provided, to pursue any policy which would lead to unbalancing of capital structures, by following the line of least resistance in financing, it is the duty of the industry and of the Investment Bankers' Association to force such offenders into line. Only in this way can the high standards already established be maintained.

Utility engineers trail in average engineering income

MORE than half the membership of the American Society of Mechanical Engineers responded to a professional-income questionnaire on which the committee on economic status of the engineer has just reported. The typical mechanical engineer in 1930 earned $7,600 at the age of 55. The highest-paid groups, management and consulting, continue their increased wage up to 60, but the lowest-paid group cease to increase at the age of 45, which is so often called the dangerous age in all industry. Activity in the metropolitan districts and Middle West produces the better returns in general.

Education pays because the statistics show that it commands a margin of about $1,000 after the twentieth year out of college. It does not, however, pay well those who administer it, because teachers lag behind engineers in other employments all the way to the age of 55. The perquisites in this field by way of supplemental professional income seem not to compensate for the deficiency in salary. Such perquisites in railroad engineering employment are hardly evident, and railroads show a low level of pay for engineering talent.

Public utilities begin to lag in their salary schedules for engineers at 35, and the salaries flatten out in a discomfiting manner at 45. For those who ascend to executive utility positions, however, there is undoubtedly the same sort of differential above the median as the $3,500 which is the figure for the whole group at the age of 50. Just why public utilities should pay little better than railroads and colleges is not manifest. They do not live on charity and endowment, and they certainly suffer none of the competitive hazards of the railroads of today.

The advance of the utility industry has been founded primarily on the technical contribution of the engineers, and they are entitled to a more just reward for their dedication to this work. These statistical facts should arouse a determination on the part of the proprietors of utilities to adjust their schedules to parity with other engineering occupations, taking due account of stabilization through depression periods and similar differentiating features.

It would be equally interesting to know how electrical engineers fare. Undoubtedly they would be just as responsive to an attempt to get the facts. Those facts should be ascertained and published.

Diesel future promising

THE Diesel engine has had a checkered commercial history. At first it was enthusiastically heralded by its advocates as the most economical engine available and the ultimate prime mover. On the other hand, the public utility interests for a long time carried on a vigorous campaign against all Diesel engines. A survey of the electrical field here and abroad now indicates that the use of this engine is slowly expanding and that it is finding its place in industry. Even the public utilities are finding room for it in their systems. The Diesel engine must henceforth be considered as a factor in electrical power costs in many industries and also as a factor in studying power system growth.

At present one finds Diesel electric locomotives increasing in numbers, and they now appear to

have an economic place in railroading. Diesel electric units are also used extensively in marine service. Public utilities now consider Diesel engines for outlying and isolated plants. They also serve as possible peak-load units. As such they are used to some extent abroad, and one large station is under consideration on this side of the Atlantic. Their principal advantage is that they can be installed at load centers and can thus relieve distribution systems of large losses at the time of peak loads.

These engines involve no stand-by costs and can be started on very short notice. Load can be added rapidly after speed is attained. Their disadvantage for peak-load service has been the small sizes that have in the past been offered, the large foundations necessary and the large floor space per kilowatt needed—an expensive factor in city locations. But these objections are daily becoming of less importance. Foreign builders have offered engines of much greater capacity than formerly and at prices which place them upon a competitive basis with steam-turbine plants. Many sets of 5,000-kw. capacity are in operation in South America, and these and larger sets are now said to be offered abroad at unusually low prices.

If the Diesel engine is to occupy a large place in the electrical industry of America, it must be developed with the following factors in mind: First, designs must be standardized and put upon a production basis to bring costs in line with those of European engines, permitting competition with the steam-electric station; second, competent operators must be shop-trained and furnished by the manufacturers to handle these units properly; third, accurate cost records must be kept of all cost elements to demonstrate the true economics of such a plant.

Much can be done in the further improvement of this engine. It has been suggested elsewhere that co-operative research among American builders is greatly needed and to be desired. Contradictory statements are prevalent in regard to the true costs of power from Diesel plants. Publicity for all such data is a vital necessity.

There appears to be an increasing sphere of usefulness for the Diesel engine in the electrical industry. It is therefore incumbent on those in the industry to keep in touch with and encourage this development, since there are possibilities of lowering electrical production costs through it.

Modern electric furnaces come into their own

SO NATURALLY, and apparently inevitably, are continued progress, increased efficiencies, bettered products and lower costs achieved in all branches of the electrical art that near-miracles cease to amaze us. We accept improvements as reasonable for no more tangible reason than the mere passage of the years, and the tremendous amount of research, thought and capital devoted to even comparatively minor developments may be overlooked. Yet the approach to perfection has seldom been achieved without a hard struggle.

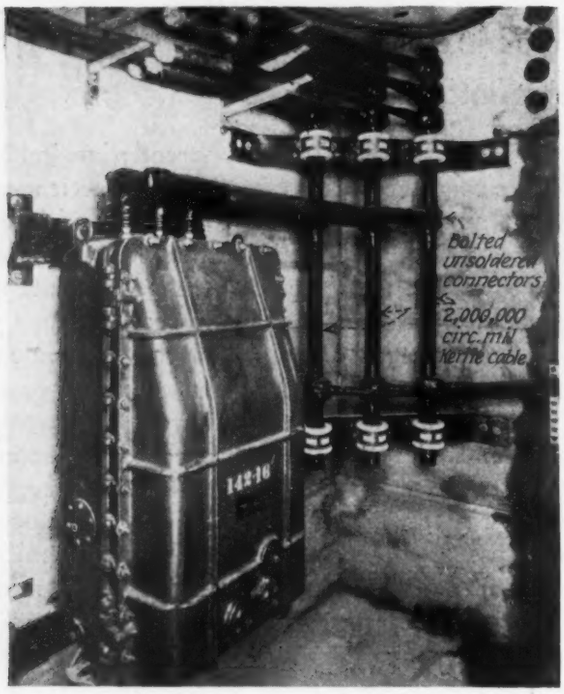
This was forcibly brought out by W. E. Moore in addressing the meeting of the Electrochemical Society in Salt Lake City recently. From most timid and humble beginnings the electric furnace has surged forward under careful guidance and continued study to a point where the objections of the most captious critics have been stilled. The steel makers, who once complained of high costs when producing steel or iron electrically, have found that many of their customers now insist upon having this electric steel or iron, whatever the cost, for it is no longer a mere whim and fancy but a real and stern necessity in meeting competition for results. Modern machinery, built to fine limits and without excessive factors of safety, requires utterly dependable, light-weight, stronger and tougher material of definitely predictable characteristics for bases of fabrication. More and more is virtually all industry seeking just this sort of thing. To the power-company executives who long looked upon the electric furnace with its high concentrated load as somewhat of a menace, causing serious disturbances to old-fashioned distribution systems, this equipment is no longer the bugbear that it once was.

Today, as Mr. Moore points out, the electric furnace is, of all power using equipments, no doubt the largest user of power per any given number of employees, and for that reason the electric furnace load may be "dumped" more readily than any other type of load, without throwing a large number of employees out of work provided "freezing" risks are avoided.

Perhaps it is a bit too soon to look forward to the day when electricity will be used in the production of all steel; but we are close indeed to the day when virtually all steel used in high-grade machinery must be electrically made.

Simplification and

Combined transformer and manhole vaults save excavation expense. Secondary bus replaces junction box.

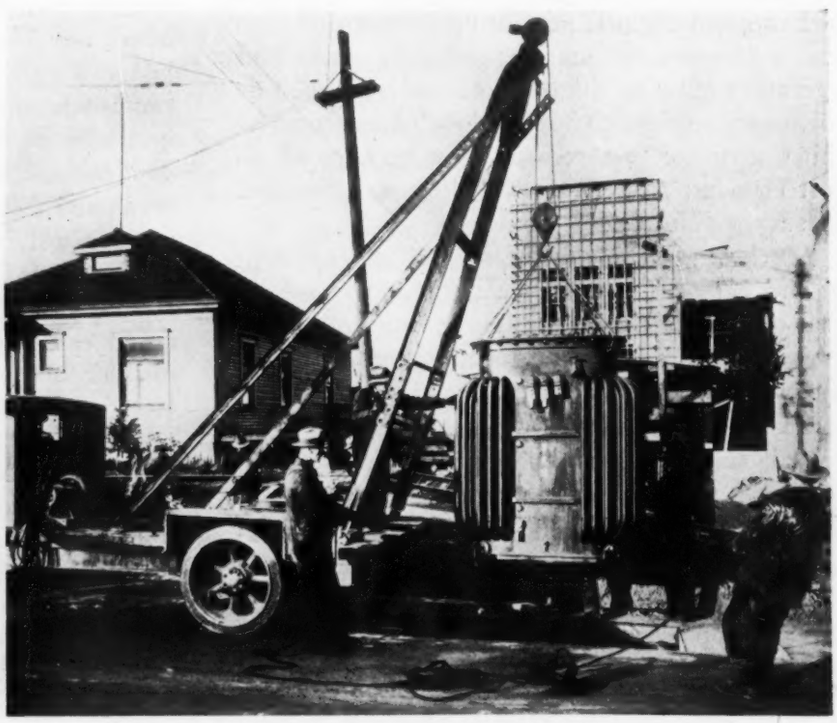


Network protector and secondary bus in manhole adjacent to transformer vault

IN MAKING additions to the original 120/240-volt, three-phase delta network installed by the Puget Sound Power & Light Company in Seattle in 1921, advantage has been taken of new developments and several features making for simplification and economy have been incorporated. In order to conform to generally accepted standards, 120/208-volt, three-phase mains for light and power are being installed in new territory around the edge of the old network. The 208-volt mains are being tied in with the 240-volt mains, however, by the installation of a three-phase, 240/208-volt transformer of sufficient size to transmit the capacity of the 500,000-circ.mil secondary mains. This makes it unnecessary to split the secondary network system into sections. Experience on this system indicated no need for dividing up the network and losing the many advantages of keeping the entire network interconnected as a solid grid.

The substation originally built to supply the networks was designed for an ultimate capacity of 25,000 kw. in 2,400/4,160-volt primary feeders. As the load is about to exceed this capacity, recent extensions have been made using a 13,800-volt primary feed from other substations stepping directly down with subway transformers to 120/208 volts in accordance with the system now generally used in other cities. It is planned in this way to prevent further growth on the 4-kv. substation and avoid the construction of additional transforming substations between 13 kv. and 4 kv.

Some of the construction features on the new work have effected simplification and economy. The secondary junction box formerly used at the point where leads from the network protectors are connected to the secondary network has been eliminated, and in its place a secondary bus is built in the manhole near the network protector as shown in one of the accompanying illustrations. This bus is built of 2,000,000-circ.mil annular core, I-beam center cable, of "Kerite" or similar non-leaded type, and taps are made with bolted connectors. The I-beam core provides a cable of large diameter and heat-radiating ability. The elimination of the lead sheath precludes the possibility of short circuit to ground at that vulnerable point and wide separation prevents phase short circuits. Experience of this company indicates that this

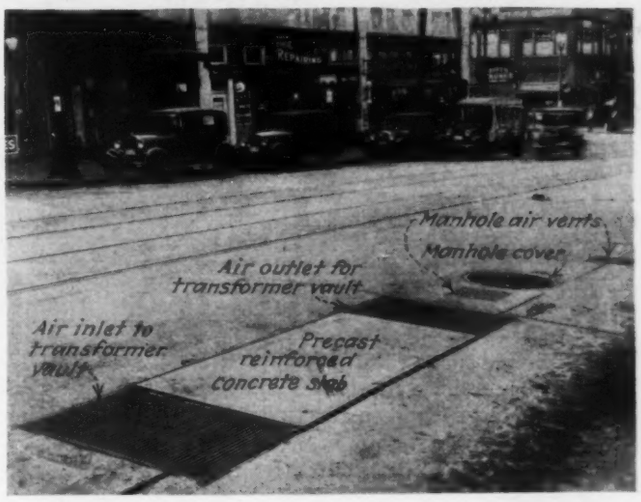


Lowering 450-kw., three-phase transformer into vault

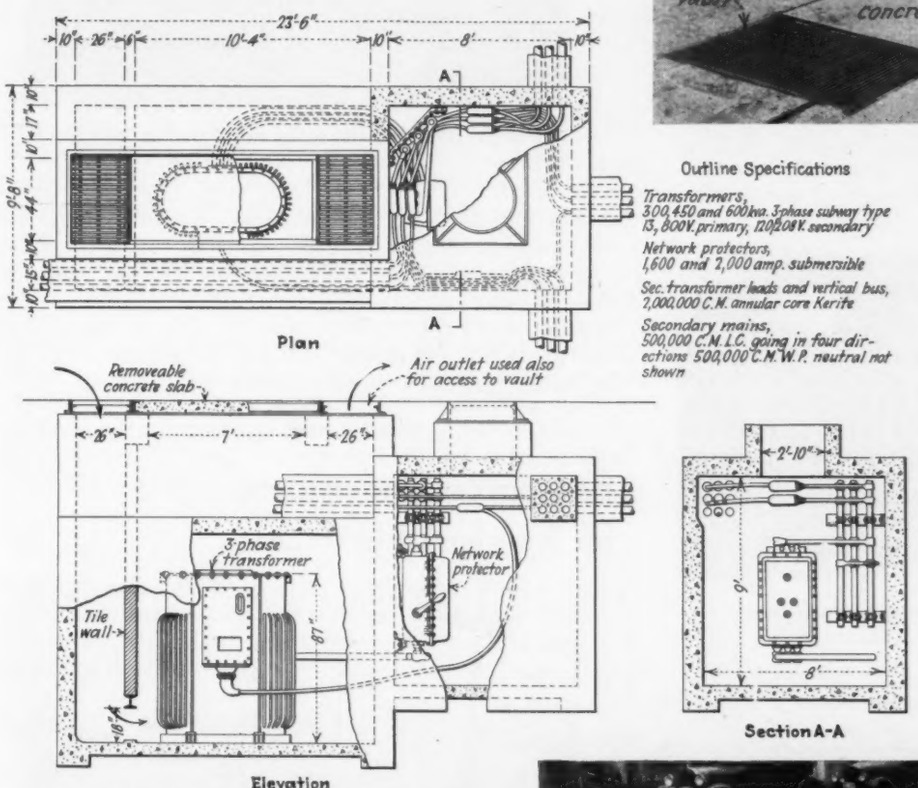
Economy in A.C. Network Practice

type of cable will stand up better under submersion than the flame-proof type of cable used for this purpose on many other systems. Similar cable is employed between the network protector and the transformer.

Another recent development is the use of a combination manhole and transformer vault, shown by the accompanying drawing. On a number of systems in the East it has been the practice to install the network protector in a separate compartment from the trans-



Street surface of standard vault and manhole

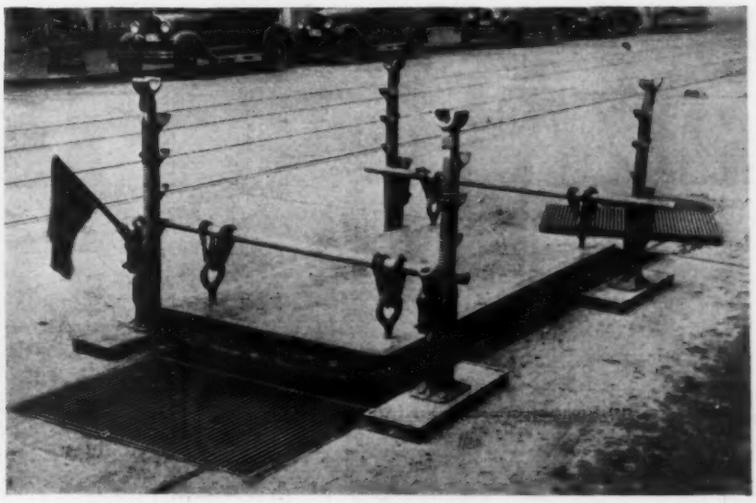


Combination transformer vault and junction manhole

One common wall is provided and only one excavation is necessary, effecting economy in construction cost.

A total of 24 of these combination vault and manholes have been built and have proved very satisfactory. The standard size is large enough to accommodate a 600-kw., three-phase subway transformer, although the largest units installed so far have been 450 kw. These are three-phase transformers with 13-kv. disconnects and ground switches built in as is now standard practice.

former and this is very effective in preventing the spread of trouble from one to the other. This has been accomplished in the Seattle system without the construction of an additional compartment by building the transformer vault as an extension along the duct run of the usual manhole which is necessary at the junction point in the secondary network.



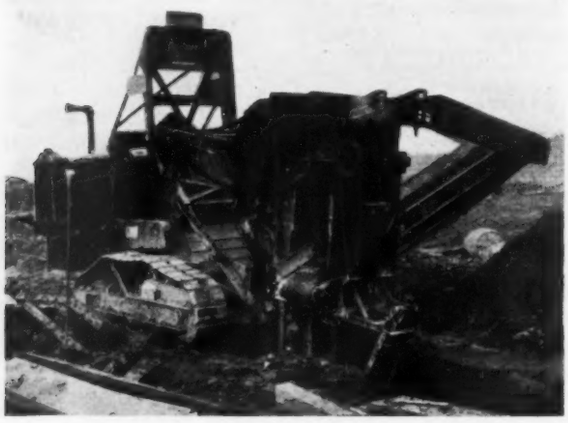
Method of raising concrete cover to transformer vault so rollers may be slipped underneath

The main opening to the vault is provided with a reinforced concrete slab cover, which is removed only in the unusual case of transformer replacement. One of the accompanying illustrations shows the scheme used for lifting this slab sufficiently to slip rollers underneath. Another shows two additional openings in the roof of the vault which are covered with grillwork for intake and outlet of air. The outlet opening is hinged and used for access to the vault by workmen. Two small ventilating openings also are provided in the roof of the manhole to provide adequate ventilation.

▼

Trench Digger Pays for Itself on One Job

Purchased at a cost of approximately $7,000, the trench digger here illustrated more than paid for itself on one underground construction job of the Puget Sound Power & Light Company in Seattle, Wash. The machine digs a trench 22 in. wide and a little over 7 ft. deep,



Trenching machine reduces underground construction costs

dumping the dirt to one side or onto a low dump truck. Excavating for 12 manholes, 15 transformer vaults, 42 hand-holes, and 11,358 trench-feet of nine-duct-run subway was done on one job with this machine.

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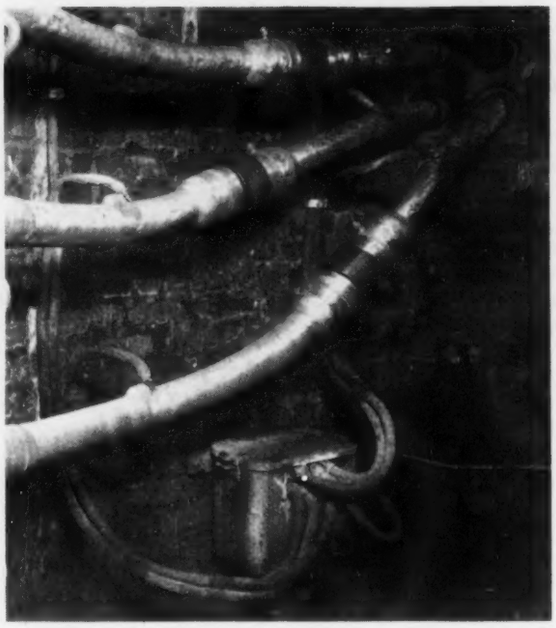
2 per Cent Added Cost Raises Cable Rating 36 per Cent

Economies in the installation and operation of single-conductor, high-voltage, oil-filled cable produced by the devices shown in this picture, taken in a manhole on the system of the Commonwealth Edison Company, Chicago, are strikingly at variance with their modest appearance. The devices are an H. & M. sheath-bonding transformer and three H. & T. sheath-insulating sleeves. Their combined effect is to reduce the induced currents in the cable sheaths so greatly as to permit a winter rating of 188,000 kva. on this 132-kv., 1,100,000-circ.mil line. Without them the rating would have been only



Sheath bonding transformers and insulating sleeves raise cable rating

138,000 kva. Also the particular bonding connection they employ keeps the sheath potential at 12 volts or less —a range that safely avoids sheath corrosion—for conduit sections twice as long as would be possible if cross bonding were used. This means a large saving in costs for joints and manholes. All this for an increased cost of cable installation of only 1.8 per cent.

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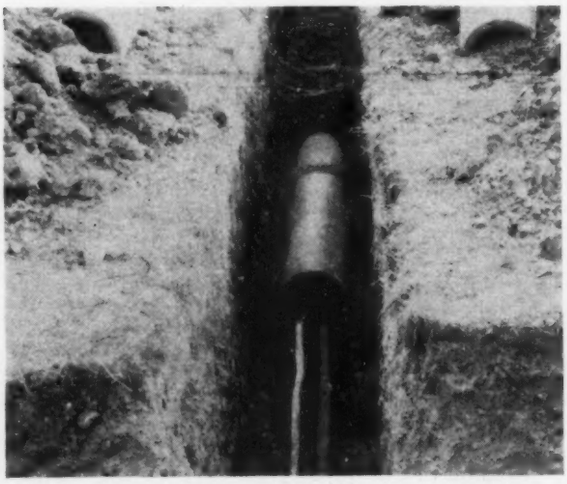
Economical Underground for Residential Districts

Standard lead-covered cables are laid directly in the ground in machine-dug trenches and covered with lengths of standard precast concrete sewer tile, split lengthwise, in a type of inexpensive underground construction for



Primary and secondary cables with neutral protected by sewer tile in machine-dug trench

10-ton transformer placed with small portable crane

residential districts used by the Puget Sound Power & Light Company. A single-conductor primary cable, a two-conductor secondary cable and a common-neutral wire are laid in the same trench. Transformer manholes are built where needed. Services are tapped on at any point by lifting lengths of tile and splicing directly to the secondary cable.

This construction can be put in at a cost of about half that of the standard duct-run type of work and about twice the usual overhead pole-line distribution costs. In high-class residential districts, where the revenue per block is high, the investment ratio may not be materially changed as compared with overhead distribution in the average community.

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Flexible Forms Used to Construct Tangent or Curved Duct Runs

Flexible hollow-rubber forms may be laid in the position desired for duct lines and separated by wooden forms that can be removed as soon as the concrete is poured. After the concrete has set the flexible forms are pulled out, the tension being sufficient to contract their circumference and permit withdrawal.

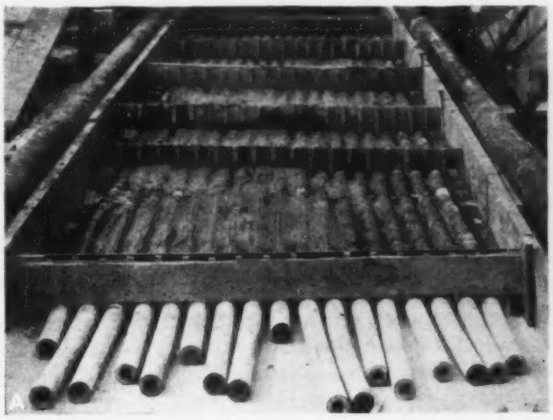
1,500-Kva. Transformers Installed Underground

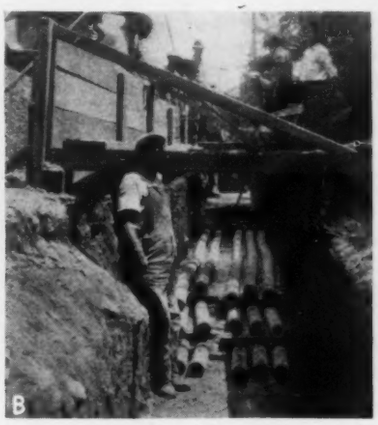
In the first underground vault to be constructed for the Duquesne Light Company's 22,000/4,000-volt Verona network it was decided to install a single transforming unit of 1,500 kva. capacity. Installation was accomplished by removing the unit from the low-level truck on which it was brought to the site by means of a small wheel-mounted portable crane and swinging it directly to the vault opening. No difficulties were encountered, although this 10-ton load had to be carefully handled through small clearances. The single balanced beam used (shown in the accompanying illustrations) facilitated the handling, providing an easy means of attachment as well as making non-laborious the guidance of the unit through the vault opening.

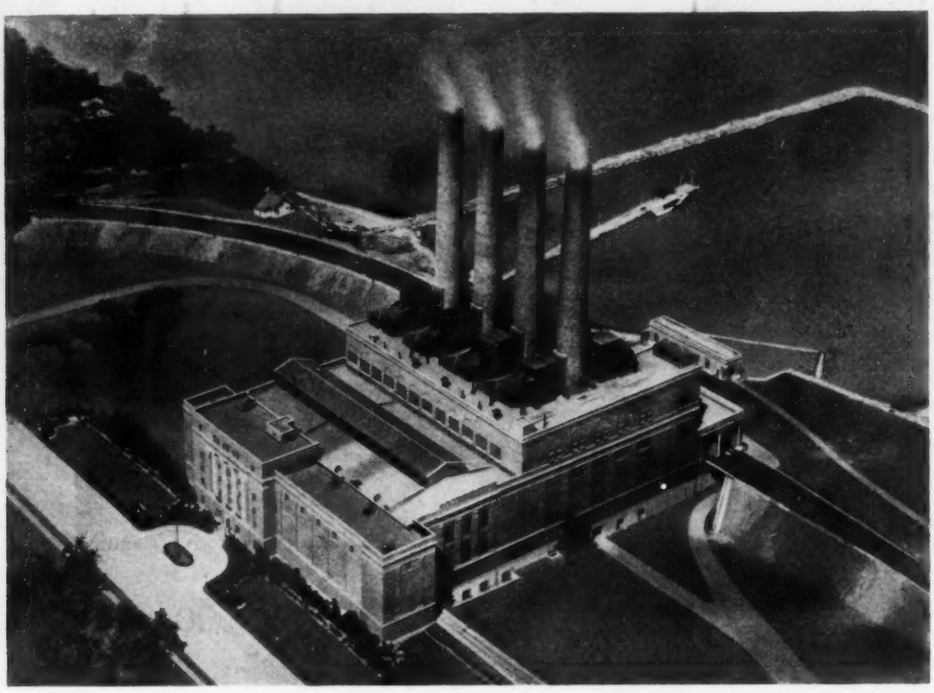
A—Spacers separate rubber forms while pouring concrete

B—A 15-duct run being constructed with rubber forms

C—Bends in this vertical run easily made with rubber forms







Current Opinions About Power Stations

Prominent engineers discuss present fuel-burning-station practice and give their opinions of trends

POWER-STATION practice has been in a rapid flux for ten years. Greatly improved economic and thermal performances have been accompanied by changes in equipment, designs, pressures and temperatures so that a multiplicity of innovations have been made. What is the present consensus of opinion in the light of these experiences?

A small group of outstanding power-station engineers have answered some questions proposed by the editors, and their replies are submitted as being competent and pertinent. It is indeed gratifying to find so much agreement to exist, for such a questionnaire even two years ago would have produced a multiplicity of contradictions.

The consensus of opinion is that the outdoor type of fuel-burning station has little economic merit and serious operating disadvantages—that far more will be gained by simplifying and joining together power equipment for space economy. It is even doubtful whether there is sufficient economic justification for placing non-steaming equipment outside or upon the station building.

And aside from economic and operating considerations there is the public relations asset of having a well-designed architectural structure as a power station. This may be had at a reasonable cost and, in place of the outdoor station, money would be spent to advantage in improving the architecture of power-station buildings, where there is ample room for improvement. One can visualize a unit structure without interior partitions and with an exterior simplicity and beauty that would be looked upon as an architectural asset to the community.

In the near future power-station practice will consist of the use of unit systems. Each unit will consist of a boiler, turbo-generator and auxiliaries. Accompanying this trend in design will be the complete built-in assembly of the necessary equipment—one might say factory-built. Enormous savings in space and improved availability factors will follow from taking advantage of unit assemblies. The apparatus will be joined together and will be adapted to operate with minimum maintenance and control. This trend forces the elimination of the boiler room, turbine room and switch house; it places all equipment on one foundation; it puts the essential controls at the unit; it avoids duplications in any primary or secondary equipment. Some day plant owners may buy, install and operate a unit power station as they now buy a turbo-generator.

Answers to these questions lead to the thought that the big future station will be made of an assembly of unit power stations without any steam or electrical connections between units. This conception, at one extreme, considers a power-generating unit as a complete assembly that either operates or is closed down, and the economic argument for this trend is that it permits of great

savings in first cost by the avoidance of busbars, steam cross-connections and auxiliary cross-connections. In addition, there are operating advantages and stations can be built better in steps of capacity where each new increment can be modern without restrictions imposed by equipment or buildings already installed. Nor should it be forgotten that the trend in transmission is to use transmission lines as unit assemblies in the same manner. In the large metropolitan systems both the network idea and synchronizing at the load lead to direct connection to load feeders without station busbars upon which all units are paralleled. It should also be noted that existing stations can be modernized most readily and cheaply by utilizing this trend.

Buy or operate industrial stations?

If the function of a utility is to make and supply electric power in the most economical manner for all available loads without any inhibitions about its own system, and if the biggest increment of load lies in the industrial power stations, then why doesn't the utility buy or operate these stations? It would insure to them skilled operators, more reliable power and ample power as their loads grow. It would permit the utilities to tie the industrial plants to their systems so as to get the economic values out of interconnection. On a generalized basis of economy and function there is only one answer, and that is that this is a business the utility should go after. But there are big questions of finance, policy, liability, permanency and public relations involved. These may or may not offset the economic advantages in a particular instance. However, the conclusion is inescapable that each utility will do well to analyze its particular industrial-plant prospects with the idea of cutting red tape and forgetting tradition in order to get more and better business.

Low prices for oil and gas and for improved internal-combustion engines introduce, at least in certain localities, a new type of competition for the utility which has a widespread transmission system with concentrated generation. Very often a dollar-and-cents analysis of cost of power production in these areas leads to conclusions favorable to local power generation. The utility then has the alternative of building a local plant or of letting some one else do it. As a general policy—and conditions are only acute in certain areas—the utility should build and supply power locally. This results in minimum costs and gives increased reliability because of multiple generating plants on the transmission system. No one can count on the future prices of oil or gas or the development of internal-combustion engines, but it is the part of wisdom to watch developments and plan utility systems to take advantage of all possible economies in order to meet these conditions intelligently. They put a caution signal out for those who advocate extended transmission systems supplied from a few large generating stations.

Shall older stations be modernized by the superposition of high-pressure units or shall they be placed in standby and reserve service? No general answer can be made, but undoubtedly the practical and economic handicaps of old stations are becoming greater. The old equipment and the buildings do not lend themselves to the new ideas in design and assembly. Labor is so expensive that tearing down costs as much as rebuilding. The architecture and design of old buildings will in many instances not meet modern requirements.

With the new unit generating idea, the use of high-capacity units, the lack of cross-connections, direct feed to outgoing lines and with the relatively small dollar differential between modernization and a new station, there is need for a very close scrutiny of modernization proposals, and the future apparently will see even less justification for modernizing stations built before 1920.

What pressure and temperature to use

Very interesting replies were had to the request for cost estimates for the 400, 600 and 1,200-lb. stations. The first-cost estimates range up to 15 per cent greater for the 1,200-lb. station than for the 400-lb., with a total power cost estimate of the same range in favor of the 1,200-lb. plant. No definite answer or conclusion need be made except that the differential is relatively small and any economic advantage may be offset by an operating disadvantage.

A careful scrutiny of the replies and survey of the art leads to the conclusion, however, that a 600-lb. or 700-lb. station with a steam temperature of 800 deg. to 850 deg., without reheat, is a very logical design for large stations in that it will equal the economic advantages of other types and display decidedly better operating and reliability aspects. The upper limit of temperature, however, is just beyond the verge of proved practice for station equipment.

What is your opinion of the relative advantages of the proposed outdoor type of fuel-burning station? Do you believe the practice is valid and economical and that it will apply chiefly to large unit generating assemblies?

A. If by "outdoor type" is meant a boiler plant having no housing whatever, I see no advantage, and I believe that the saving in building cost will not warrant this type of construction above 30 deg. north latitude.

B. While the differences in cost between an outdoor and a fully housed power station may run as high as 10 to 15 per cent where a monumental type of building is used, recent estimates indicate that an entirely satisfactory type of building can be provided at an additional expense of about 3 per cent, and in my opinion the only advantage of the outdoor station is this 3 per cent saving in first cost.

C. I believe that the outdoor type of fuel-burning station has advantages which will require it to be considered in a number of instances.

D. Where material snowfall and sub-zero temperatures do not prevail in the winter season, the proposed outdoor type of fuel-burning station appears entirely practicable. Maintaining coal-handling facilities at ground level and absence of building superstructure offer material capital savings to be offset by cost of added protection to equipment. The scheme would apply more to the larger undertakings.

E. Operating labor objects to outdoor work in cold weather. Adequate protection of such a plant from the weather involves added expenditures which offset in a measure the savings from the elimination of superstructure. Outdoor fuel-burning stations will have limited applications in American central-station practice in the Northern states.

F. That portion of the investment which might be reduced is limited to building walls and roof. Foundations, substructure tunnels and steel superstructure would remain practically the same. This reduction might be offset by the increased cost of insulation and other protection against inclement weather.

G. To date, I do not believe that sufficient saving in construction cost is to be made by the outdoor type of fuel-burning stations in order to justify the operating inconvenience which would probably be encountered.

H. It is very evident that reduction and

simplification of building structures offer an opportunity for reduction in investment in power stations. The degree to which this can be accomplished will depend on climatic conditions and on the personal opinion of those responsible for the station design. Turbine manufacturers are apparently prepared to build units which will operate satisfactorily without protection from the weather and remote-reading instruments are already available which are necessary for the successful operation of equipment of this type. So far as boilers are concerned, it is quite evident that these could also be designed to stand the weather with a relatively small inclosure for the operating force.

On analysis, however, it develops that the reduction in unit investment due to building elimination is relatively small because of the necessity for foundations sufficient for the equipment and for cranes, bridges, etc., which are necessary to facilitate erection and dismantling.

I. The only advantage to be expected with the proposed outdoor type of power station is reduced investment cost, with possibly some reduction in operating labor. The feasibility of constructing such a plant in this climate is open to question, and I believe that progress should not be too rapid.

J. The proposed outdoor type of station in any climate will be more difficult to operate and decidedly more difficult to maintain. I do not believe the practice will prove to be valid or economical, and if used at all it should be for small units which may be readily temporarily housed for maintenance work.

K. I believe the relative advantages of the proposed outdoor type of fuel-burning station as compared to the completely housed installation will decrease materially as the size of units increases. The building cost is greater with smaller units. The entire building cost cannot be saved, so it is possible with sufficiently large units (considerably over 200,000 kw. in size) to arrive at a point where outdoor design might be more expensive than completely to house the equipment.

L. The outdoor type of fuel-burning station is undoubtedly soon to be here. It will have the advantage of lower investment and operating cost. I do not believe that it will be limited necessarily to large generating assemblies; medium-sized units of this type will undoubtedly prove economical.

In the development of high-capacity boiler units do you believe there will be a general shift toward what might be called a unit generating assembly with one boiler, one turbine, one generator and accessories designed as a unit structure with its own controls and accessories?

A. Availability factors for both steam-generating units and turbo-generators are becoming nearly the same. More extended knowledge of auxiliary control, of furnace operation and of boiler-water treatment will make the availability and reliability of the two systems practically the same.

Under such conditions the logical form of generating station is the "one boiler, one turbine" unit, each with its own complete control and auxiliary system. Emergency tie-ins on the steam, boiler-feed and electrical systems may be provided in a simple manner, but are not absolutely necessary.

Large-capacity boiler units are now available which can be operated continuously at high ratings and high efficiencies. The use of a large number of small boilers operated at moderate ratings for each turbo-generator is no longer economically justified, and these will be used to a decreasing extent in newer stations, even in those employing reheating.

B. Yes, for units of around 50,000-kw. capacity.

C. I believe there is a decided tendency toward what might be called a unit generating assembly with one boiler, one turbine, one generator, and the auxiliaries arranged accordingly. Modern methods of burning fuel, preparation of feed water, elimination of refractory furnace lining and improvement in boiler auxiliary equipment have resulted in making the boiler plant as reliable as the turbine plant.

D. I believe that there will be a general shift toward the unit generating assembly having one boiler or one turbo-generator. The controlling factor in this case will be the saving in first cost, which may amount to as much as 15 to 20 per cent of the cost of the station.

E. I believe there will be a distinct trend toward one-boiler, one-turbine plants installed as complete steam-electric generating units with a minimum of cross-connections. I have made some preliminary studies, considering units varying in capacity from 25,000 to 75,000 kw., the 75,000-kw. capacity unit to have two boilers. Two steam conditions were considered—450 lb. at 750 deg. and 675 lb. at 850 deg. The plants were to be ultimately of four-unit capacity and to have no common connection except an emergency boiler-feed pump and a common evaporated-water storage tank. Auxiliary generators driven by the main turbine were to supply power to the essential auxiliaries. There was also a common control battery for operating electric circuit breakers, relays, etc., used to supply auxiliary service. The indications are that such a plant can be built at a cost of from 20 to 25 per cent less than for a standard plant with the same steam conditions.

F. Yes. The trend is unmistakably in the direction of unit assemblies.

G. I believe that there will be a general shift toward the unit type of generating assembly with one boiler and one turbine designed as a unit structure.

H. There is undoubtedly a tendency toward simplification of station design, the single-boiler, single-turbine unit with a single piping system being the ultimate in this direction.

I. I believe there will be a general shift toward what might be called a unit generating assembly; that is, one boiler to a turbo-generator. Whether it will be found advisable to go further than to reduce materially the size of steam connections between units is questionable, but I do believe that even though it is not found advisable to eliminate cross steam connections entirely, it certainly is to be expected that in new large plants there will be a tendency toward a reduction of size.

J. I believe that there is a strong tendency to build future stations on a unit basis.

K. I believe there is a tendency to shift gradually toward a unit assembly.

Do you believe the paralleling arrangements and the reserve arrangements of both steam and electrical apparatus in power stations, with consequent elaboration of piping, buses and auxiliaries, will be replaced by single-line steam-electric units and accessories going directly to outgoing lines?

A. Our experience indicates very clearly that it is possible to purchase and install the various pieces of equipment that make a complete unit so that they may be expected to have equal reliability and may be operated together as a unit for periods as long as one year without a shutdown for overhauling. We have operated a boiler-turbine unit meeting the system requirements for periods in excess of six months without difficulty. In one case the capacity factor for the run was in excess of 80 per cent. The run was terminated for no other reason than that my curiosity got the better of me and I took the boiler out of service for three days so that I might inspect the inside of the furnace.

B. The extent to which elaboration of piping, buses and auxiliary equipment will be replaced by the unit system will depend upon how much faith the operator has in the reliability of his equipment. I do not think that the adoption of the so-called unit system mentioned in your question will tend to reduce elaboration and duplication to a minimum.

C. Yes.

D. This is a question on which there can be sincere differences of opinion. Many engineers, while ready to concede the advantages of the single-line units and accessories, will still demand certain paralleling and reserve equipment on the theory that the losses to a utility in case of emergency through lack of such paralleling equipment would more than offset the carrying charges on this equipment. A certain amount of paralleling and reserve equipment will be carried even with the unit system.

E. This condition practically exists now. It is the trend of the unit system. Undoubtedly, paralleling arrangements will tend to decrease with reserve capacity of steam and electrical accessories as the unit system becomes more recognized and proves its reliability.

F. I believe that there will be a material reduction in the paralleling arrangements for reserve, and in that way elaboration of piping, buses and auxiliaries will be replaced by single-line steam-electric units and accessories going directly to the lines.

G. The simplification of mechanical and electrical equipment is a part of the general simplified station design.

H. It is my opinion that while the "unit" assemblies will be the general basis for future stations, auxiliary supply will be either interconnected or at least two sources provided, and I believe that electrical systems will be so designed that generated load may be transferred or relayed between generators in emergencies.

1. Experience has shown that the more complicated installations are not only more expensive to maintain, but with the large interconnected systems the necessity for them has been materially reduced; in fact, in many cases the complicated steam piping system has caused more trouble in operation than it has prevented.

On large systems do you think service and economic considerations favor the use of several medium-sized power stations as against the building of single and very large stations? In these relative designs, which bids fair to permit a minimum of reserve capacity? Maximum service reliability? Minimum over-all system generating cost at delivery points?

A. Service considerations in a large system favor the use of several medium-sized power stations. Economic considerations alone may or may not favor the large single station, depending upon local conditions. Several medium-sized power stations undoubtedly permit the minimum of reserve capacity as it is only necessary to carry this reserve in one station. Maximum service reliability is secured through several well-distributed stations, as line troubles, cyclone or snow damages and other outages are more readily localized without upsetting other parts of the system.

B. On large systems, assuming that fuel and condensing water supply does not create too great a differential, service and economic considerations favor meeting the load with several medium-sized power stations rather than from one very large station. Reserve capacity, service reliability and delivered-power-cost comparisons do not influence this opinion so much as the fact that the multiple-station plan is more flexible in meeting an unusual load growth in any one area; also, system stability is more certain over a term of years at lower capital cost.

C. I believe that service and economic considerations will favor the use of more than one power station as against the building of a single very large station to serve a given system. Less reserve capacity is required and greater service reliability results where a system is served by more than one station. I should think also that system generating cost at delivery point would be lower.

D. In my opinion both service and economic considerations favor the use of several medium-sized stations as against the building of single and very large stations. The principal reason for this statement is that the continuity of the service is better safeguarded by several stations so isolated from each other that a single accident will not be able to cause a complete shutdown on the system.

E. Where systems serve metropolitan centers, economic conditions may be generally expected to favor the use of several plants, particularly where all transmission from generating stations to substations must be underground. In so far as reliability is concerned, I see no reason why one large station having a sufficient number of units of the proper size may not be expected to perform as satisfactorily as a number of smaller stations; certainly, the one large station can be operated at a lower labor cost.

F. It is becoming increasingly more difficult to build generating stations in the more desirable locations. Any given system would have to be analyzed, and, subject to ability to build stations at desired locations, the remaining determining factors would follow the last three items in this question, but not in the order named. My arrangement would be: (1) Maximum service reliability, meaning continuous and well-regulated service; (2) minimum over-all system generating cost (meaning net output) at delivery points; (3) a minimum of reserve capacity consistent with the two foregoing requirements.

G. I believe that service and economic considerations favor the use of medium-sized plants against the building of large and single plants.

H. The demands of the service determine very largely the power generation layout of any system.

I. On large systems covering considerable territory I believe the use of several medium-sized power stations is preferable to a single large station. There is undoubtedly a tendency to provide more reserve capacity in the case of several medium-sized stations than in the case of the large single station, but the former will probably show greater service reliability and less over-all system generating cost at delivery points than the latter.

J. The relation between medium size and very large stations is entirely one of degree. Offhand, it would appear that the minimum of reserve capacity necessary would result when separating the system generating capacity into a number of stations. If the medium-sized stations have the same size boilers and turbines as are assembled in the single very large station, the minimum over-all system generating cost at delivery points would be practically the same, particularly if we assume in the large station that there is no interconnection of the boilers. The slight additional overhead, due to the separate stations, would probably be offset by savings in transmission losses.

K. I believe that service and economic considerations favor the use of several medium-sized stations as compared to a single very large station. The former method permits the installation of less reserve capacity, produces greater service reliability and, when transmission costs are taken into consideration, gives the minimum over-all system generating cost at the delivery point.

It is said that the remaining increment of power load for utilities lies in the large industrial plants that have their own plants for power and steam. Aside from policy matters, do you believe utilities could own or operate these plants on a more economical basis than they are operated at present, because they could be tied into the utility system? What disadvantages do you see in utilities owning or operating these industrial power and steam stations?

A. Undoubtedly, economies can be realized by the operation of combined steam and power plants for service of large industrial plants by the public utilities. The principal disadvantage of such an arrangement is the possibility that the utility may make large investments in such plants which are of value to one industrial plant only, such investment being practically useless in case of an industrial depression affecting the particular plant concerned.

B. I believe that in a great many instances public utilities could profitably own and operate plants serving steam and power to large industries. The extent to which this can be done would depend on the relative size of the steam and electric loads of the industries served and the relation of their steam demand and electric load to the total load on the company's system. The relative effect of business depression on the industries' load and on the public utilities' load might have an effect on the desirability of the project, as instances might arise where advantages could not be taken of the surplus electric power generated from the steam sold. The permanence of the industry and the possibility of having to change the plant serving it to a condensing type of station would have an effect also on the desirability of the project.

C. In those instances where I have been called upon to investigate the practicability of our company owning or operating plants located at or adjacent to a specific industry I have always arrived at the conclusion that we could work out some scheme which would result in appreciable saving to the industry and permit of our obtaining a profitable customer. It is, of course, apparent that in an industry whose demand for heat is just about satisfied by the heat resulting from the generation of sufficient power to operate the plant a central-station company cannot possible fit in to advantage.

Frankly, I have never seen or heard of such a condition—either there is an excess of power available or, as is more generally the case, a seasonal excess of available heat. Apparently, the greatest difficulty in the way of obtaining such business is the seeming inability of the central-station engineer to appreciate the soundness of what appears to him to be a rather arbitrary point of view on the part of the industrial engineer with particular regard to the needs of his industry. I have, I believe quite successfully, operated plants owned by and located on the premises of industrial undertakings to the entire satisfaction of the manufacturer and at considerable profit to our company, such an arrangement being the only possible means of obtaining customers' electric load. However, I know of no such instance where the solution finally agreed upon was the most economical either for the central-station company or the customer. As an operating engineer I see only one real disadvantage to such an arrangement; namely, that the central-station company operating any considerable number of such plants cannot help but ultimately be in a position where it will be open to attack from labor unions, which will be in a much better position to organize men of one operating company than they

would be to organize effectively a relatively small number of men in each of a number of industrial undertakings.

D. Whether the utilities can, with advantages to both, own or operate the power and steam equipment in large industrial plants cannot be expressed as a generality. Usually the industrial power and process steam requirements are not a well-balanced complement to each other for any material length of time, and a power connection to a utility will correct the situation. With a potential profit or saving for both parties existing, operation by the utility of the industrial power and steam equipment presents no difficulties.

E. The greatest handicap to economical operation of large industrial plants by the owners is that this part of the industry is generally considered as contributing only a small element in the cost of the industrial product. Little thought or money is expended in securing its best operation. In the hands of utility operators whose main objective is to obtain power at lowest production cost this industrial plant could undoubtedly be operated more economically by being tied into the utility system.

The principal disadvantages of such a tie-in are the relatively higher fixed charges on the industrial plant than on the central station, the non-simultaneous demands for steam by industry and power by the utility, and frequently the superimposing of the peak loads of both utility and industry when load demands of the former are at a maximum.

F. On an academic basis this question is easily answered. It is a well-known fact that most of our generating stations could supply a vast amount of off-peak power at low costs without interfering with availability for utility service, provided convenient arrangements could be made with the industry. Where process steam is required, and if possible to build the plants adjacent, even greater economies are possible.

G. I believe that it will probably be necessary for utilities to make arrangements whereby they lease or rent large industrial plants in order to supply both exhaust steam and power to the industry. It is more economical for the utility to own or lease these plants, as it supplies the reserve from which power can be taken from the industrial use and from which power can be delivered from the industrial plant at times of unbalance of steam and electric plants in the particular industrial plant under consideration. The disadvantages in such arrangements are the extreme complication of working out satisfactory contracts which will hold under the varying conditions to be encountered.

H. Apparently the stations which have been built by the utilities for supplying both steam and electricity to industries have been successful, particularly where the steam and electricity load were not well balanced and the utility could consequently take advantage of its ability to supply energy to its electrical system or take energy from it.

I. I believe the utilities could operate large industrial plants on a more economical basis than they are operated at the present time.

J. I believe the utilities could own and operate plants for the delivery of steam and electric power where the steam requirements are large on a more economical basis than they can be operated by individual industrial plants.

K. I believe the primary disadvantage is that the utility's money is tied up in a plant for a specific use, and should anything happen to the industrial. this power plant may be idle. For this reason it might be well for the industrial to have a material amount of money tied up in the power plant although the ownership should lie with the utility.

With the present scale of oil, gas and internal-combustion engine prices, do you believe the competition of local power production in newer plants and smaller plants is greater? Do these conditions point to an economic trend to make power at the load instead of transmitting it over transmission lines?

A. Undoubtedly the competition of local power production from internal-combustion engines is greater than formerly and will increase. Very low prices are being quoted on large Diesel plants in Canada and South America, and quantity production of such units will further lower costs. In Ontario the oil engine is making progress even under the unusually low rates quoted by Ontario's Hydro-Electric System. These conditions all point to an increasing amount of local power generation in industry by internal-combustion engines, and the same trend will soon become evident in the United States.

B. (a) Naturally competition is more vigorous. (b) Not apparent so far.

C. In my opinion the economic trend is toward the generation of base loads at large central stations, the peaks being carried by a smaller plant located near the load centers.

D. In some sections of the country there seems to be an increase in competition from power generated locally from oil, gas and internal-combustion engines. I think these are the result of the local situation rather than of any trend toward making power at the load instead of sending it over transmission lines.

E. The opportunity for competition from smaller and newer plants is undoubtedly greater than ever before, and at no time has such an effort been made to develop them.

If the over-all costs of the small plant, whether internal-combustion engine or steam turbine—meaning thereby the total of production and operating costs plus investment charges—is less than can be delivered from a central-service system consisting of one or more generating stations with transmission system, the economic thing to do is to install that plant. Please understand that maintenance, retirement, obsolescence and depreciation are necessarily included in the above discussion.

There is no trend, or evidence of trend, and power will still be generated for large load centers at a compromise location favoring water, fuel, transportation and load.

The smaller plant must contend with capacity factor of the central-station systems. High thermal efficiencies of the internal-combustion unit, together with the remarkable economies of smaller steam turbine plants, cannot, except in case of a very favorable capacity factor, offset the additional cost from investment not utilized. The advantage of load diversity is lost or limited.

Lack of true engineering knowledge, influence of political propaganda, engineering whims and ambitions, together with executive inability, are more responsible for the smaller competing plants than any real merit in the small-plant assembly.

F. I do not believe the present scale of oil, gas and internal combustion engine prices in our territory is increasing the competition.

G. While the internal combustion engine is apparently offering competition in certain localities, and in relatively small units, there has been no evidence of serious competition with large steam-generating systems. The density of the system load would doubtless be a determining factor in the consideration of internal combustion engine installations.

H. The questions involved under this heading require rather elaborate analysis and also should include the nuisance and noise element involved in local generation with internal combustion engines. There is, of course, a decided campaign under way by the manufacturers of this type of equipment, and so far serious counteracting influences have not been brought to bear on the question.

I. In the East I do not believe the oil, gas or internal combustion engine situation will have a material competitive effect in locations where the power rates are low. It may have some effect for smaller outlying plants in thinly populated territory where the cost of serving them is higher. I believe the oil situation is transitory and that most of the intelligent industrial managers realize this. I do not believe that natural gas with internal combustion engines is a serious competitor.

J. Competition from the internal combustion engine is rapidly increasing. In many instances this type of engine has made it more economical to generate at the load instead of transmitting over long transmission lines. In my opinion this competition will increase.

Do you believe utilities can economically modernize old stations and improve their efficiency by the superposition of high-pressure units? Is this preferable or more economical than building a new station and using older stations for peaks and standby reserves?

A. In some instances I believe utilities can economically modernize old stations and improve their efficiency by the superposition of high-pressure units. Whether or not this is preferable to or more economical than building a new station and using the older stations for peaks and standby reserves would depend upon the conditions.

B. Where the rebuilding of an old station can be accomplished by replacing old turbo-generators by modern units without major changes in the boiler

plant, such rebuilding can be economically accomplished. It has been my experience, however, that where major changes in the boiler plant are required it is usually cheaper to start an entire new station where design will not be handicapped by existing building limitations.

C. In general, it is preferable to build new high-pressure stations where most favorable operating conditions may be secured and to use the old stations for peaks and for standby reserves.

D. Many stations of considerable size in service the past twelve to fifteen years have equipment in good order that can be revamped with good economics. Boilers can be increased in steaming rate 50 to 75 per cent with modern combustion devices and water walls. Larger turbines with maximum steam-bleeding features can supplant the present units on their foundations, and the existing condensers with added circulating water provisions and some change in the steam lanes may prove suitable. The station in this way may be increased 50 per cent or more in capacity at low cost. The steam pressure and cycle are not greatly changed. The ability to serve peak loads quickly remains, and the stand-by reserve character of the plant is improved. Unless the cost of fuel is unusually high, this method may give a lower over-all power cost compared with the large replacements of boiler equipment when superimposing a high-pressure cycle on the existing turbine room or building a new station of the same additional capacity.

E. Such investigations as I have made indicate that the load factor of the upper increment of demand for the average system is so low as not to warrant building a new boiler plant to increase plant economy.

F. The answer to this would depend on the character of the equipment in the old station and the character of the load. It might be safely hazarded that this practice may become more general than in the past owing to the greater adaptability of present-day equipment to such an arrangement than that of former days.

G. It is impossible to generalize on whether or not old plants can be modernized economically. There are undoubtedly many of them which can be, either by having higher pressure steam boilers and turbines installed on top of their present cycles, or having a mercury cycle superimposed.

H. The economics of each case must be worked out for that particular job.

I. Each case requires a very careful consideration of all the facts involved in order to arrive at a correct answer.

J. This depends entirely on the relation of the utility's load factor and its proportion of old and new equipment.

K. I believe it is possible economically to modernize old stations to both increase their efficiency and output by the superposition of high-pressure units. Whether this is preferable or more economical than building a new station depends entirely upon the relative efficiency of the stations to be modernized as compared to the other stations on the system and the relative dollar efficiency of a new investment.

What would you estimate to be (a) the relative first coat in per cent, (b) the busbar total kilowatt-hour cost in per cent, for, say, a 400,000-kw. station using:

1. 400 lb. pressure, 750 deg. steam.
2. 600 lb. pressure, 750 deg. steam.
3. 1,200 lb. pressure, 750 deg. steam.

What is your opinion of the relative operating reliability of these three types of stations?

A. For hypothetical 400,000-kw. stations, the capital cost ratios in per cent would be: 400-lb. pressure, 750 deg. F., 100; 600-lb. pressure, 750 deg. F., 106.5, and 1,200-lb. pressure, 750 deg. F. 112.5.

50 PER CENT CAPACITY USE FACTOR

Fuel cost per 1,000,000B.t.u., cents	8	14	8	14	8	14
Operating cost ratio, per cent	100	100	88	72.3	83.3	68
Total: (Operating cost and capital charges ratio), per cent	100	100	98.7	96	100	96

With well-chosen design and equipment there is practically no difference in operating reliability. For new work the use of 600 lb. pressure and 825 deg. to 850 deg. F. temperature without reheat for a steam cycle seems to be an interesting solution.

B. I have made no figures to indicate the relative advantages of the set-ups given in this item, as it is assumed that the 600-lb. and 1,200-lb. plants use reheat. Such figures as I have made indicate rather clearly that 450-lb.-750-deg. stations are best suited for operating on a system which is also fed by hydro plants where during certain seasons of the year the turbine units must be started up and shut down frequently. While I have no actual figures to back up my opinion, I nevertheless have a "rather strong hunch" that a 675-lb.-850-deg. plant might be expected, all things considered, to have an economy comparable with a 1,200-lb.-750-deg. plant using reheat, while the first cost of the 675-lb. plant might be expected to be the lower. It would seem safe to assume that a 400-lb.-750-deg. plant would be somewhat more reliable than either of the plants using reheat—if for no other reason, simply because it has fewer pieces of equipment and less piping.

C. Regarding difference in first cost of stations of the type and capacity mentioned, considering the 400-lb. pressure station as 100 per cent, I would say that the 600-lb. station without reheat might cost 2 per cent additional. If the reheat cycle is adopted, the additional cost would be from 7 to 15 per cent. If 1,200-lb. pressure is used with reheat cycle, the additional cost over that of a 400-lb. station would be from 5 to 10 per cent. This applies to stations greater than 100,000-kw. capacity and in units of 50,000 kw. or larger and is based on a steam temperature of 750 deg. With the adoption of 850 deg. steam temperature the use of pressures from 600 lb. to 750 lb. without reheat becomes attractive.

D. I have made comparative estimates of the first and operating costs of 400-lb. and 1,200-lb. plants. These estimates indicate that the 1,200-lb. plant will cost above 2 per cent more than the 400-lb. plant and will generate a kilowatt-hour at a saving of approximately 7 per cent in cost. In my opinion, there is no difference in the relative operating reliability of the three types of stations mentioned.

E. Estimates of this will vary with design. First-cost differences could be easily influenced, depending upon which combination was favored. The regeneration cycle is applied to the 400-lb. and 600-lb. stations and from the 1,200-lb. reheating and regeneration cycles.

For estimated cost assume that the 600-lb. station at 750 deg. F. is accepted as standard. The 400-lb. station might cost, if built to correspond, from 4 to 8 per cent more owing to increased size, weights and dimensions.

Assuming 60 per cent capacity factor and a fuel cost of 20 cents per 1,000,000 B.t.u., the operating costs would have approximately the following relation:

			Per Cent
1	1,200 lb.—750 deg. F.	=	100
2	600 lb.—750 deg. F.	=	103.2
3	400 lb.—750 deg. F.	=	115.2

The intermediate station would probably have the greater operating reliability.

F.

	(a) Per Cent	(b) Per Cent
1	100	100
2	106.5	93
3	105	85

In my opinion, the relative operating reliability of these three types of stations would be the same.

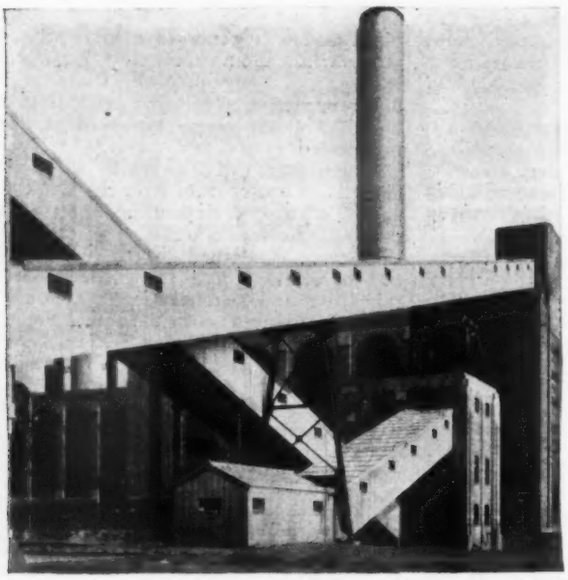
G.

	Pressure, Lb.	Temp., Deg.	(a) Per Cent	(b)* Per Cent
1	400	750	100	100
2	600	750	108	101.6
3	1,200	750	105	99.4

*Fuel, operating labor, maintenance and fixed charges at 12½ per cent. The operating reliability of case 1 will be the best; cases 2 and 3 about equal.

H. The relative operating reliability, as an offhand opinion and assuming a single boiler and turbine unit in each case for comparison. would be 85 per cent in the 400-lb. case, 82 per cent in the 600-lb. case, and 75 per cent in the 1,200-lb. case. These figures, of course, will change with added experience in the design and development of materials for the higher pressures.

I. I am of the opinion that at 750 deg. steam temperature the total busbar cost for operation, maintenance and including capital cost will be slightly less for the 1,200-lb. plant than it will be for the 400-lb. plant, and that possibly the 600-lb. plant will cost slightly more than either the 400 or 1,200-lb. plant. If, however, the total temperature of the steam is raised to about 800 to 850 deg., so that it will be possible to eliminate reheating in the 600-lb. plant, I am of the opinion that the total busbar cost for the 600-lb. plant would then be less than for either the 400- or 1,200-lb. plant. assuming, of course, that all were operated at 800 deg. total steam temperature. This is based on an annual load factor of approximately 50 per cent. If this load factor is increased up to 80 per cent the relative busbar cost, beginning with the lowest, will probably be in the order of 1,200 lb., 600 lb. and 400 lb. for either 750 deg. or 800 deg. total steam temperature. I am of the opinion that at 750 deg. the 400-lb. plant has by far the greatest reliability.

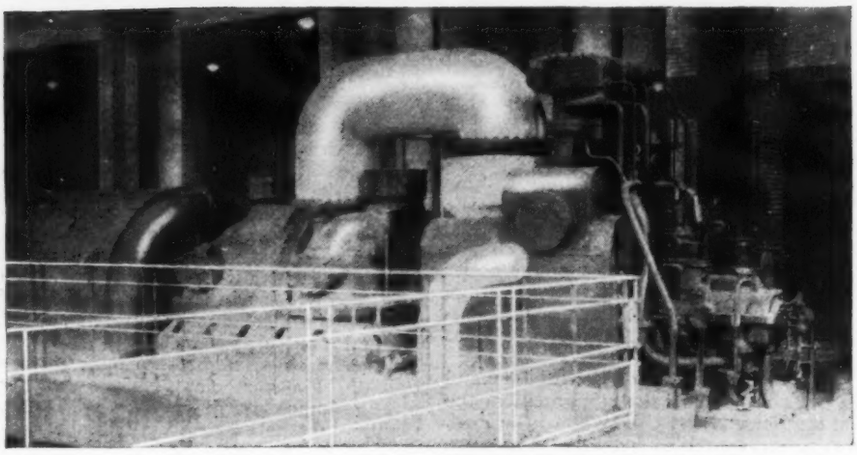


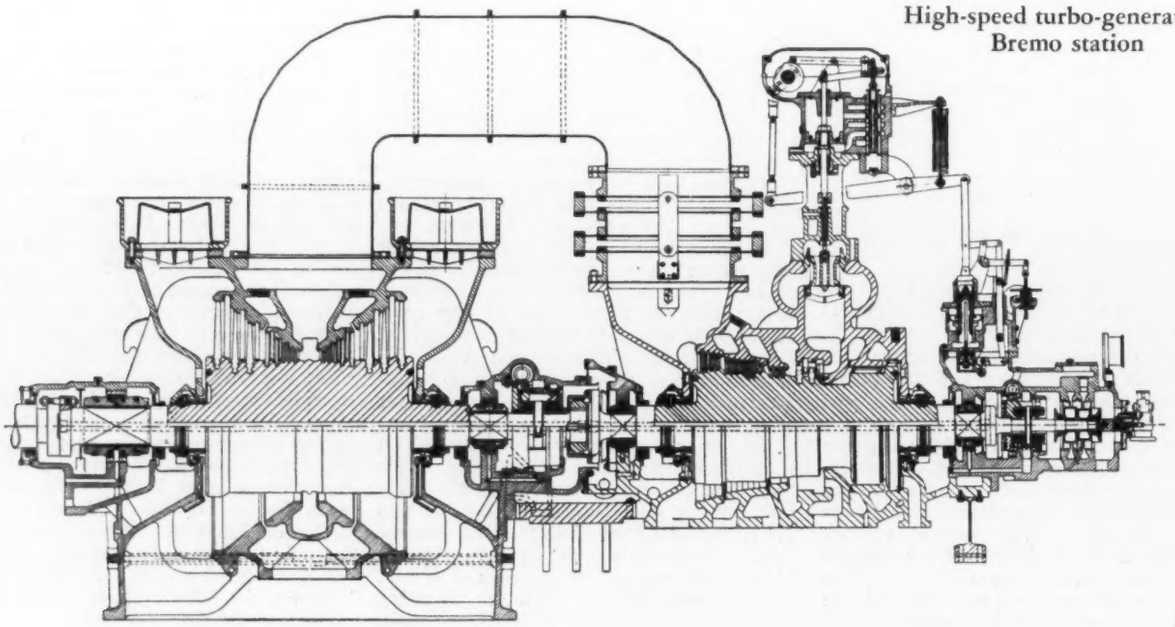
A Tandem-Compound 15,000-Kw., 3,600-R.p.M. Unit

This is one of the 15,000-kw. turbo-generators installed in the new Bremo plant of the Virginia Public Service Company. These machines are notably unusual, marking as they do a step toward higher speeds than have heretofore been used in generating practice. They are said to be the largest 3,600-r.p.m. condensing-type machines built in this country and to operate at double the speed previously accepted for common practice. This design has brought improved operating characteristics, efficiency and reduced weight without, so far as is known, any increase in maintenance costs or reduction in reliability. Operation is at 450 lb. gage, 750 deg. F. and 29 in. vacuum. The use of three admission valves offers high efficiency at various loads. Electrical output is at 13,800 volts.

Aluminum Sheeting Used for Coal-Conveyor Bridges

At the recently completed James H. Reed station of the Duquesne Light Company, Pittsburgh, corrugated aluminum sheeting has been used to advantage to inclose the inclined coal-belt-conveyor bridges. It is estimated by engineers of the Byllesby Engineering & Management Corporation, designers and constructors of this plant, that the long life to be expected of this material offers definite economic advantages as well as giving an improved and somewhat unusual appearance to the conveyor structures.





High-speed turbo-generator at Bremo station

Protecting Penstocks Where Soil Erodes Rapidly

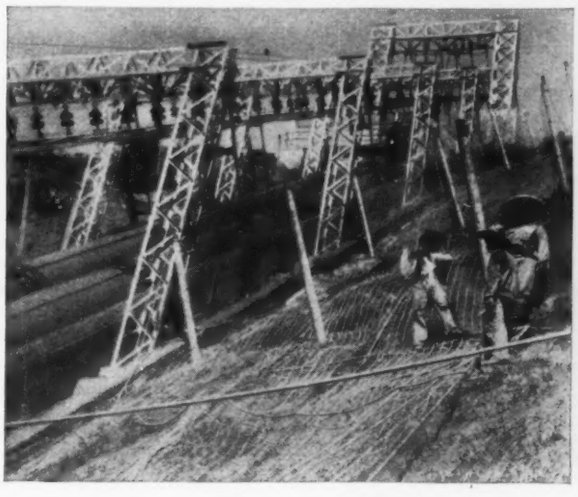
At the Botocan Falls (Philippine Islands) hydroelectric plant of the Associated Gas & Electric System an unusual problem in penstock installation was encountered, according to J. D. Fitch, hydraulic engineer Charles B. Hawley Engineering Corporation, Washington, D. C. Water for this 16,000-kw. plant has a total fall of 650 ft., 475 ft. of which is a direct drop through penstocks set at between 45 and 51 deg.

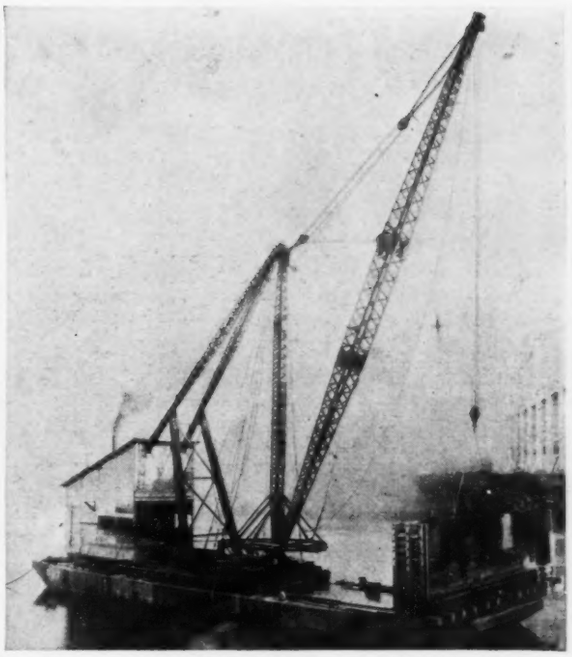
In this vicinity the soil is of volcanic origin, and upon it have been deposited seams of clay and gravel. So long as the bank remains undisturbed and is covered with trees and vegetation there is little danger of earth and other matter sliding down into the gorge, but the removal of vegetation incident to the excavation for the penstocks made it imperative that the completed penstocks and power house be protected from damage resulting from the falling of dislodged matter. Another factor contributing to the danger was the heavy rainfall, which tended to erode excavated areas and to loosen earth and boulders.

In order to overcome such difficulties a drainage system was installed and a protecting screen or mat was placed over the excavated area of sufficient strength and permanency to prevent superficial movement of earth until such time as vegetation could be restored. Supplementing this slope protection, a system of fences was built to deflect or capture any rolling material which might be dislodged from beneath the mat or from any portion of the side hill not covered with mats. A mat of galvanized wire mesh fencing, supported from the top of the gorge by steel cables and secured by anchors to the ground at frequent intervals, was laid down on each side slope of the penstock trench. These mats were guyed sideways. Concrete gutters along the bottom of the deflecting fences intercept surface drainage.

Upon completion of the protection work, the entire area, including that covered by the wire mesh, was seeded with a rapidly growing shrub, ipil-ipil, having a long tap root and spreading auxiliary roots. Thus the hazard characteristics of tropical countries were overcome.

Mats and fences check erosion of soil

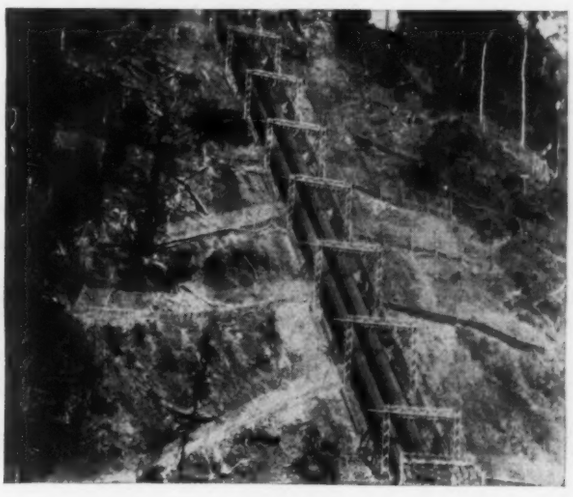




Skid Derrick at Bagnell Dam

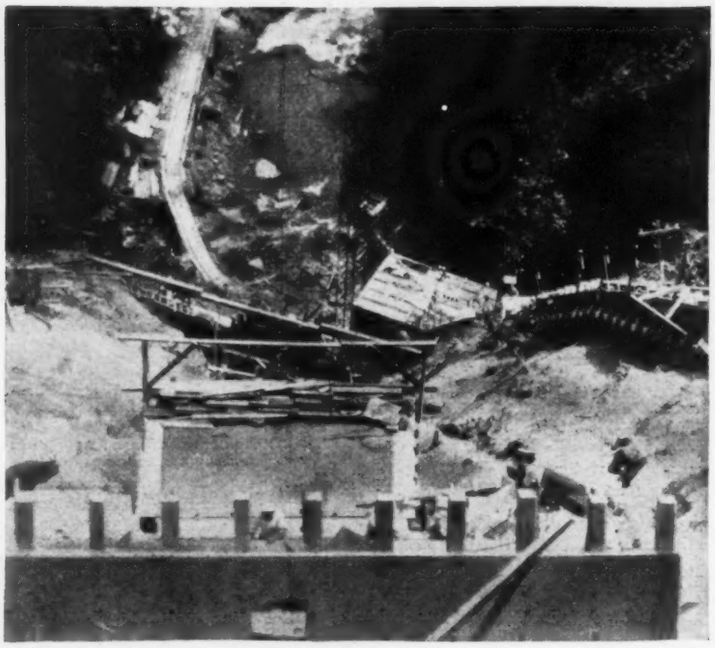
This 110-ft.-boom, 8-ton skid derrick is one of six such pieces of equipment used by the Stone & Webster Engineering Corporation in the construction of Bagnell Dam for the Union Electric Light & Power Company of St. Louis. The flexibility and adaptability of this aid to construction was conclusively proved. More than 8,000 sheet-steel piles, each from 50 ft. to 60 ft. long, were driven. The machines traveled all over the job with their own power and helped out wherever needed.

When 180 deg. of boom swing is sufficient the equipment has an advantage over the stiff-leg derrick because less space is occupied and there are no weight boxes. The skid derrick is dependent upon guys while working, but requires fewer than a guy derrick. Stone & Webster engineers offer the following comparisons in cost for guy, stiff-leg and skid derricks, all 8-ton capacity with 110-ft. boom, without power unit: Guy, $3,270; stiff-leg, $4,240; skid, $6,000. To these should be added power costs for a hoisting engine, $4,120, and slewing engine, $830.



Cableways and Chutes Aid in

Rock and sand for concrete and some penstock excavation were transported by a wood chute



Looking down penstock from top of gorge

INTERESTING problems in the use of cableways and chutes were met by engineers of W. S. Barstow & Company, the engineering and construction unit of the Associated Gas & Electric System, in building the Botocan Falls hydro-electric plant on the island of Luzon, Philippine Islands. This plant, recently completed, supplies 16,000 kw. to the Manila Electric Company, a property of the Associated System.

The power house is located in a narrow gorge 475 ft. deep, with connecting penstocks supported and anchored on the steep slope of the gorge. Delivery of construction materials and machinery to the power house and penstocks from a material yard at the top of the gorge and the disposal of penstock excavation offered the major difficulties.

A load of cement being lowered by temporary cableway

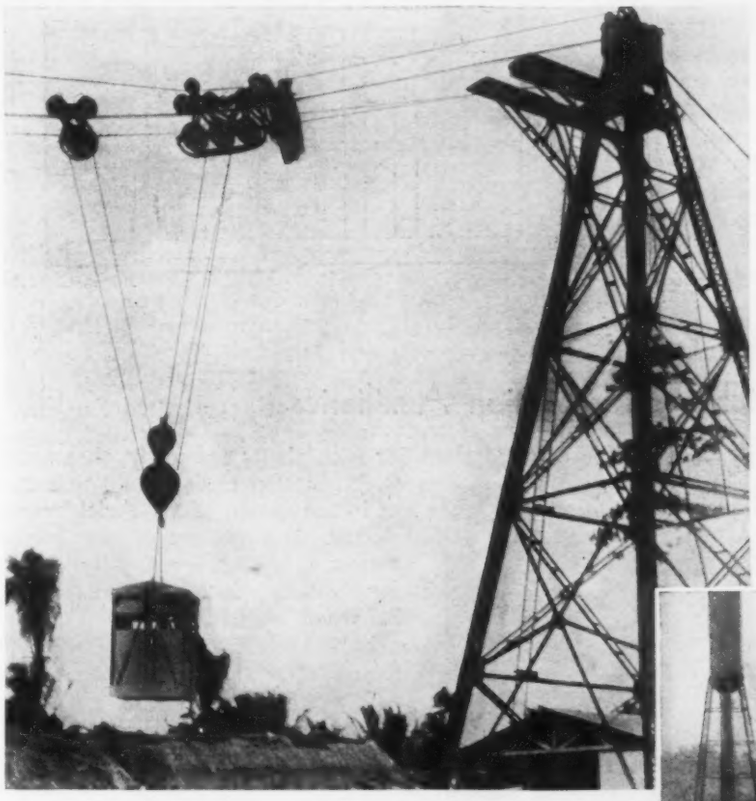
Cableways and chutes were used for the purpose. Three temporary construction cableways of 2 to 5 tons capacity and one permanent cableway of 30 tons capacity were required. All cableways had main suspension cables more than 1,000 ft. long. Power for the temporary cableways was supplied by steam engine hoists and for the permanent cableway by a motor-driven hoist.

Track approach to power house

Building Station

By G. E. SCHREIBER

Engineer Utility Management Corporation
New York



Permanent cableway tower and elevator cab

Carriage of temporary cableway
Parts of a concrete mixer being lowered

The loads destined for the power house were transported about 500 ft. horizontally out over the gorge by the cableway and then lowered to the bottom of the gorge to a platform truck operating on a track about 250 ft. long built on an embankment along the bank of the river and connected to the power house.

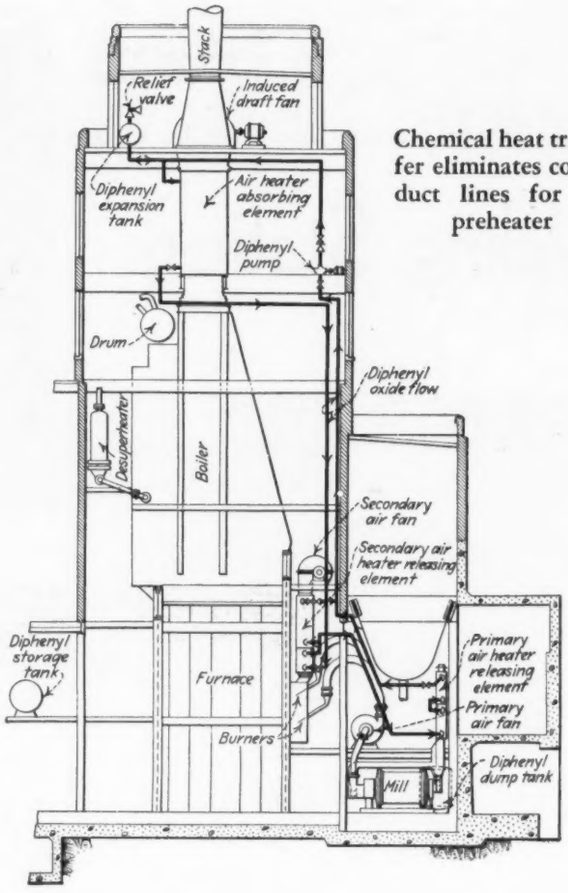
Cableways at Botocan
Note material yard at top of gorge, steel tower for temporary cableway to the right of surge tank and wood tower for temporary cableway over penstocks.

Diphenyl Oxide Used for Air Preheating

At the new Bremo station of the Virginia Public Service Company an interesting effort to increase boiler-room and heat-balance efficiencies is being made. Here diphenyl oxide is used for preheating the air needed for combustion. This involves the use of separate heat-absorbing and heat-releasing elements to handle the intermediate heat-exchanging medium. The use of diphenyl oxide was in part dictated by the necessity of minimizing the high, narrow duct work obligatory in the usual air-heating practice, for in this job the boiler design was based upon the concept of a vertical single-pass tapered construction which with the usual design of air heater would have been prohibitively costly.

The diphenyl system consists of a heat absorber in the gas passage directly above the boiler setting and several heat releasers in the air-supply ducts for the same boiler.

The medium used consists of 85 per cent diphenyl oxide and 15 per cent naphthalene. This liquid is carried through a 3-in. pipe from absorber to exchanger by a small centrifugal pump. This eliminates all the duct construction usually encountered in air-preheating installations. Another advantage involved in the use of diphenyl oxide is that primary and secondary air temperatures may be independently varied. By varying the flow of the heat medium to any heater temperatures may be fully controlled.



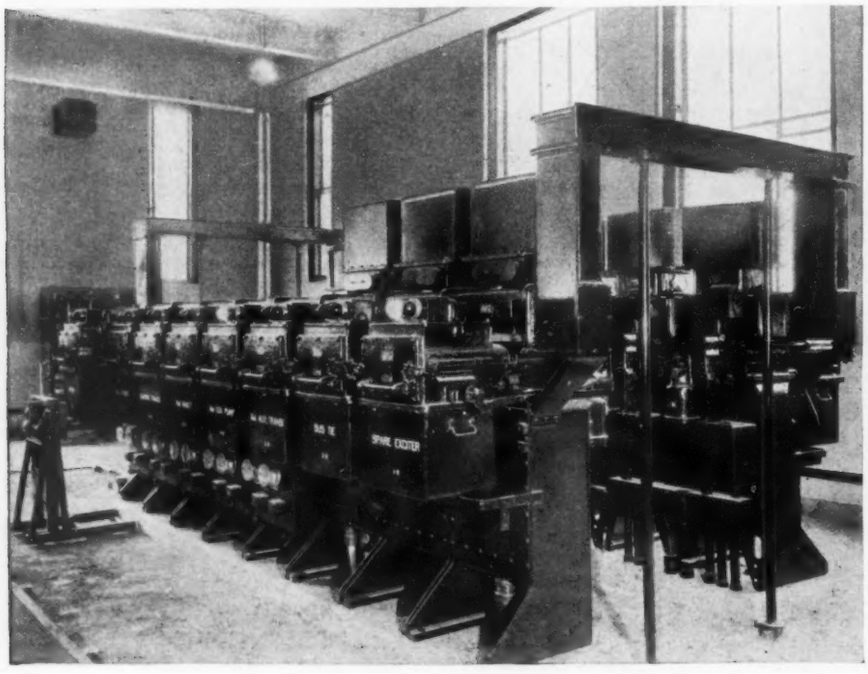
Chemical heat transfer eliminates costly duct lines for air preheater

▼ ▼ ▼

Metal-Clad Switchgear for Station Auxiliaries

Auxiliary power switchgear which provides dependable and flexible switching is an important factor in the reliability of operation of large hydro-electric plants. Where foundations for such plants are costly, then space economy in station design is also essential. These two requirements were met in the design of the Ariel hydro-electric development of the Inland Power & Light Company by installing totally inclosed, metal-clad, 2,300-volt switchgear.

Step-down transformers connected to the leads of the main generators and a 2,300-volt house generator supply the power to a 2,300-volt ring bus for the auxiliaries. The ring bus is divided into three sections with the house generator feeding into one section and the step-down transformers (connected to the leads of the main generators) feeding the two other sections. Overhead compound-filled sections carry the bus connections at the ends of the structure to complete the ring.



Service reliability and space savings for auxiliary power switching

The breakers are installed in a double row placed back to back, with an aisle between, providing access to the solenoid-operating mechanisms and control cable connections, which are mounted behind the breaker units. Each breaker unit contains within itself the oil circuit breaker, cable potheads and secondary wiring. Live conductors are either immersed in oil or imbedded in insulating compound and all parts are closed within grounded metal casings, which form the exterior covering of the unit. Breakers can be withdrawn or replaced only when in the open position and must be fully racked in or out before they can be closed. A switch truck is used by raising or lowering breaker tanks and for removing a breaker from its frame standard. All power and control cable connections are made at the bottom of the breakers.

The present switching structure contains sixteen breakers and covers a floor space 11 ft. 4 in. wide by 15 ft. long, of which a space 2 ft. 6 in. x 15 ft. is an aisle between breaker rows. The height of the switchgear above the floor is approximately 5 ft. 6 in. Owing to the compactness of the structure, the station lighting is not impaired and there is little interference to vision on the operating floor.

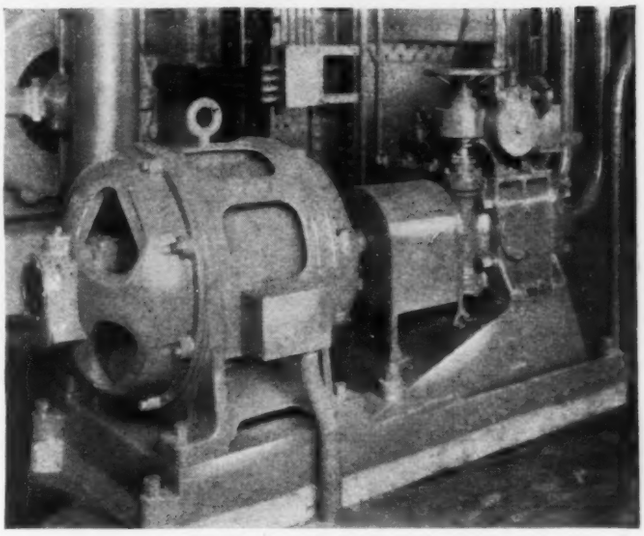
▼

Steps Saved in Operating This Station

This compact, attractive operating room centralizes the control functions of the James H. Reed station of the Duquesne Light Company, Pittsburgh. Note the easy-to-read placement of all meters, the easy to reach controls of the benchboards. No focusing of eyes at a point near by and then reading a meter twice as far away is required in this layout. The lighting panels, directly over the center of the operating aisle, provide adequate intensity at just the right angle to avoid glare and reflections from instrument faces and glasses. Panel-mounted telephones on a pantograph base and free floor conditions are other elements of convenience.

Compact layout for control of large steam station

Hydraulic Drive Improves Speed Control of Stokers

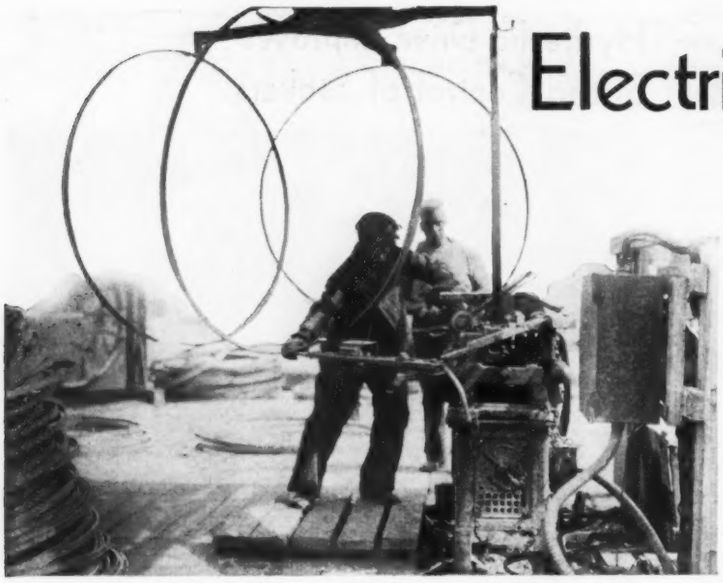


Instead of employing variable-speed electric motors and gearing to drive the stokers under the boilers of the James H. Reed station of the Duquesne Light Company, Pittsburgh, hydraulic drive has been adopted. This is said to be one of the first applications of the principle to driving stokers, although it has been used for several years in paper mills and in marine work.

The constant-speed induction motor shown in the foreground drives a rotary oil pump, the discharge and suction of which are connected by pipes to the inlet and outlet respectively of an oil-operated driving motor direct-connected to the main stoker countershaft, thus forming a closed oil circuit. The rate of oil flow through this circuit determines the speed of the stoker countershaft, hence the rate of fuel feed to the boiler. The rate of oil flow is varied to suit the load requirements by means of an internal device in the oil pump, this device being controlled by the automatic boiler control system, or by hand when desired. One oil pump and oil motor unit is used for each of the three stokers.

This arrangement, according to engineers of the Byllesby Engineering & Management Corporation, permits of much closer fuel-feed regulation over a far wider load range than does the conventional variable-speed electric motor drive.

Electric Welding Speeds

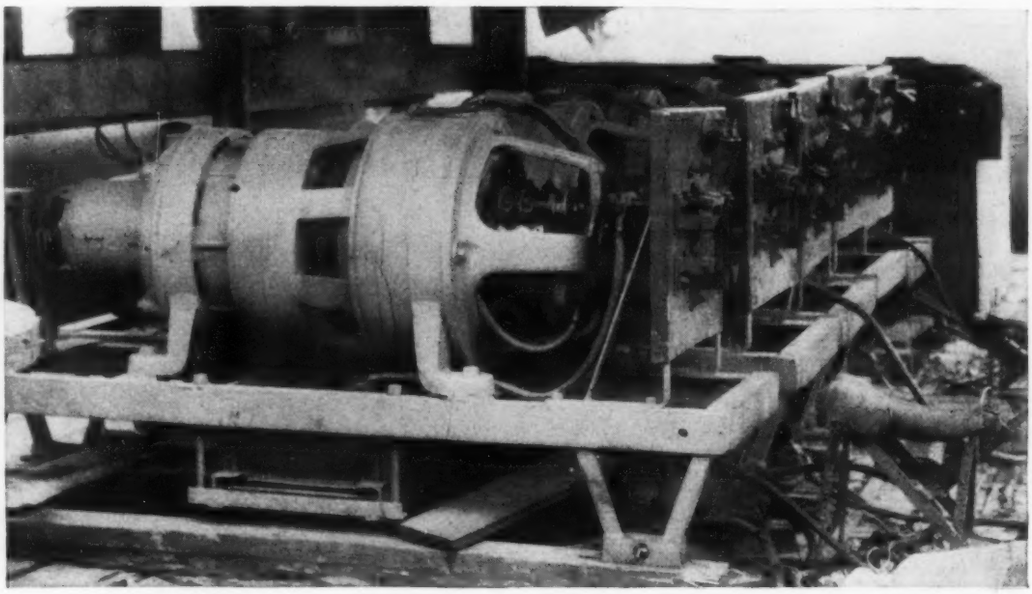


Butt-welding reinforcing hoops at the rate of 24 seconds per ring, including handling

FIVE major applications of electric welding contributed effectively to the successful field production of 30 sections per nine-hour day of mild steel pipe with reinforced concrete covering and internal lining during the past summer at the Westbrook yards of the Portland, Me., water district. Each section consisted of a 52-in. cylinder, 12 ft. $2\frac{3}{4}$ in. long, with reinforcing outside cage and interior mesh wire to receive the concrete lagging and interior surface. Each unit was provided with a ball and spigot at opposite ends for jointing and units were shipped individually in motor trucks to the line location after due setting of the concrete. The welding applications included seam arc welding of steel sheets in forming the cylinder units, three seams per cylinder being required; butt-welding of reinforcing hoops, arc welding of spigots and bells to cylinder ends, arc welding of reinforcing cages to cylinder ends and arc welding of manhole and special work castings to pipe sections. The spigots and bells were fabricated with the aid of electric welding at the factory of the Lock Joint Pipe Company, Ampere, N. J., prior to shipment.

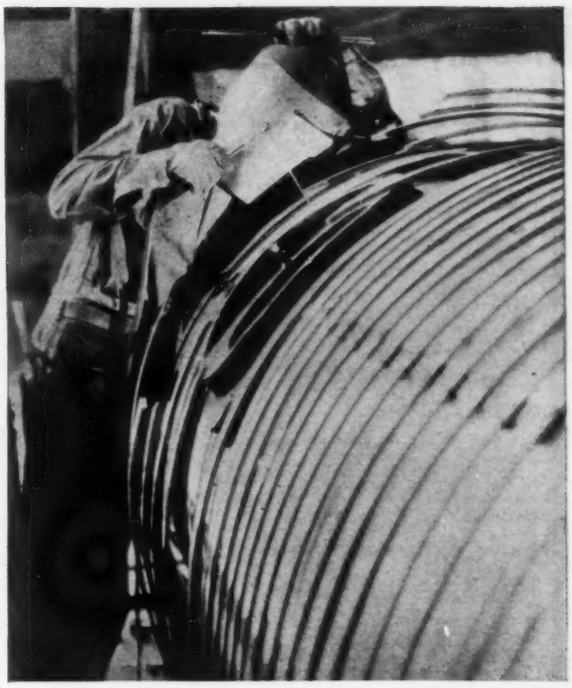
Electrically driven punches, shears and rolls speeded the cutting up and preparation of bars and sheets for welding on the Westbrook job after delivery of material from a railroad siding into the yards. The reinforcing hoops were rolled from $1\frac{1}{2}$ x $\frac{3}{8}$-in. mild steel bars and were butt-welded at the rate of five hoops every two minutes at a Federal resistance welding machine. One welding operator handled the machine and one attendant fed the rings to the welder and delivered them to a testing machine immediately after welding. The steel sheets received from the railroad were rolled after delivery and fed into a Lincoln triple arc welder for seaming. Two men at this machine (not shown) welded an average of 990 ft. in nine hours, or 55 ft. per man-hour.

The end rings for bell and spigot required 27 ft. of arc welding per cylinder and three men averaged 27 ft. per man-hour on this job. Sixteen arc welds per reinforcing cage were required, or eight welds per cylinder end, in welding the horizontal 1x$\frac{1}{8}$-in. bars and end hoops to the cylinder ends by welding these and $1\frac{1}{4}$x$1\frac{1}{4}$x$2\frac{3}{4}$-in. angle pieces to the cylinders. Intermediate bar and hoop attachments were by wire clips, and the bell end hoops were 2 in. wide x $\frac{3}{8}$ in. thick in order to resist excess strain in calking joints. In a standard pipe section for use under 287-ft. head there were 36 hoops and one bell end hoop, two more hoops being added for pipe to be subjected to 295-ft. head.



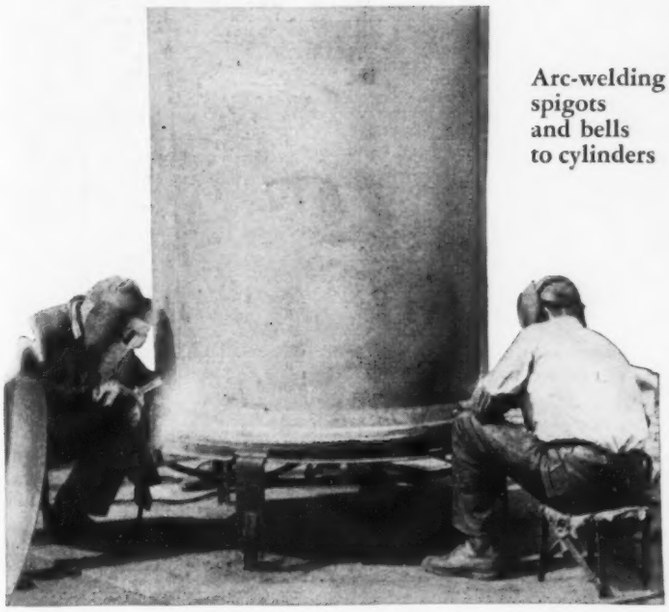
Battery of five portable motor-generator sets

Pipe Construction in Field



Arc welding manhole collar to pipe cylinder after cutting hole for its reception

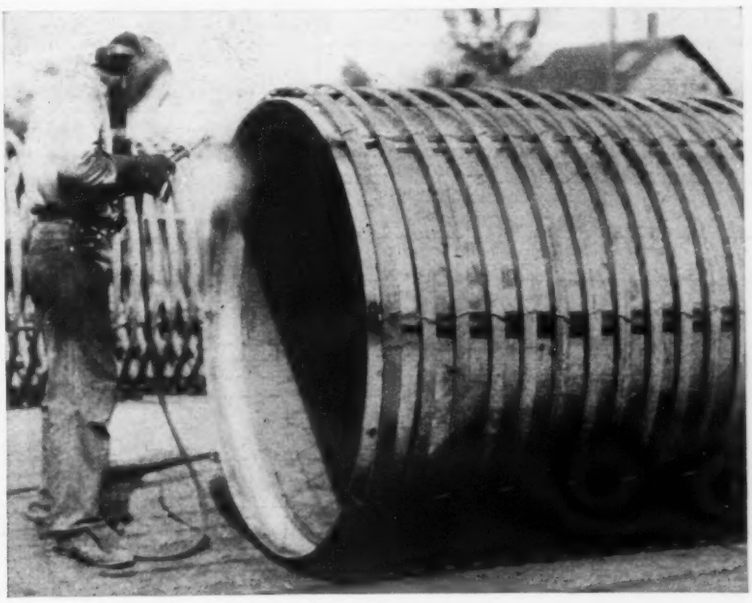
Special work was easily attached permanently to pipe sections by this method without delaying production.



Arc-welding spigots and bells to cylinders

One 400-amp, and four 300-amp. Lincoln portable motor-generator sets provided 80-volt direct current for arc welding cages, spigots and bells and all energy for the plant was supplied by the Cumberland County Power & Light Company. Grounds were provided in the yard by $1\frac{1}{4}$x$\frac{1}{4}$-in. steel strips gridironed about the premises to facilitate placing the cylinders on this connection with the negative side of the welding generators. In general, type "F G.E." $\frac{5}{32}$-in. welding wire was used in welding end rings and cages to cylinders, $\frac{3}{16}$-in. wire being used on seams.

On this work electric welding was found faster than other available methods, less expensive as to material and labor and had the important further advantage of leaving unimpaired the quality of the stock welded. The flexibility of the layout saved time even on a job where the routing of the work was planned with unusual care to avoid "bottlenecks." The accessibility of every part of the cylinders to the positive terminal of the arc welding circuit through the use of heavy-duty cable and metal strip grounds cut down the time required to prepare for welding to nominal values.

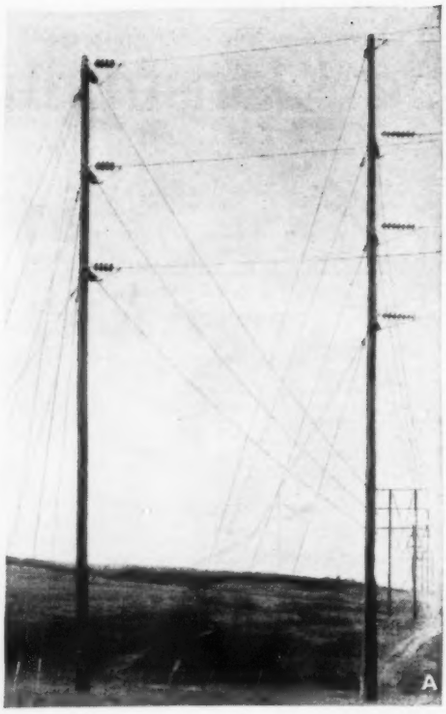


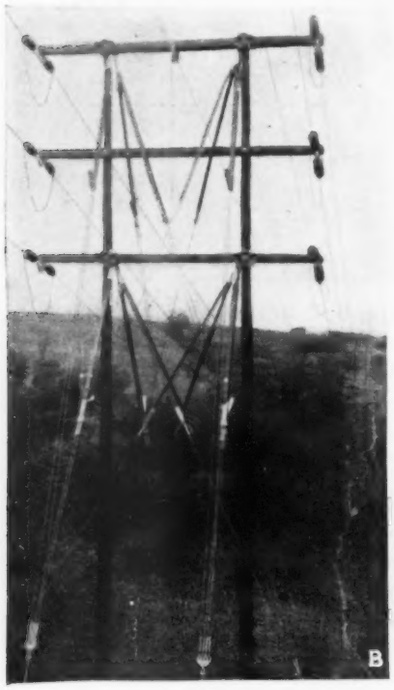
Welding reinforcing cages to water-pipe ends before concreting

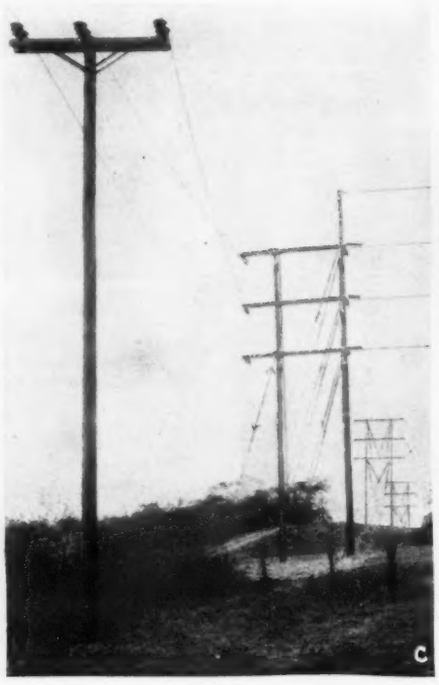
Heavily Insulated Line

Resists Lightning Storms

IN BUILDING the Ambridge-St. Joseph Lead-Valley 66-kv. line of the Duquesne Light Company special precautions were taken to avoid interruptions due to lightning, for in addition to serving the St. Joseph Lead Company, this line also provides another source of feed into an important manufacturing district. It was thus desirable to secure a high degree of reliability.







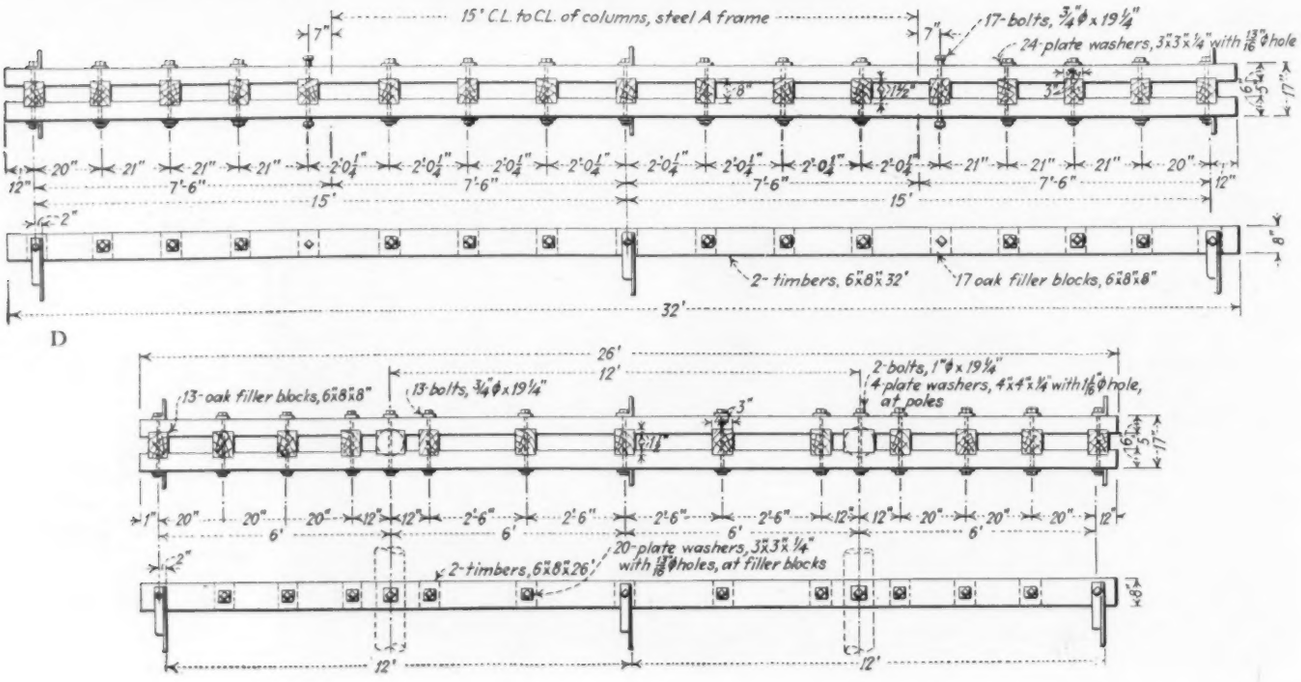
Wood insulation protects important line against lightning interruptions

(A) Vertical corners on wood-insulated line

(B) Typical 66-kv. wood-insulated H-frame on line

(C) H-frame and angle construction at line junctures

(D) Heavy-duty wood arm construction developed for wood poles and steel towers


15' C.L. to CL. of columns, steel A frame
17- bolts, 3/4" ϕ x 19 1/4"
24- plate washers, 3"x3"x1/4" with 13/16" ϕ hole
2- timbers, 6"x8"x32'
17 oak filler blocks, 6"x8"x8"
32'

D

26'
12'
13- oak filler blocks, 6"x8"x8"
13- bolts, 3/4" ϕ x 19 1/4"
2- bolts, 1" ϕ x 19 1/4"
4- plate washers, 4"x4"x1/4" with 1 1/16" ϕ hole, at poles
20- plate washers, 3"x3"x1/4" with 13/16" ϕ holes, at filler blocks
2- timbers, 6"x8"x26'

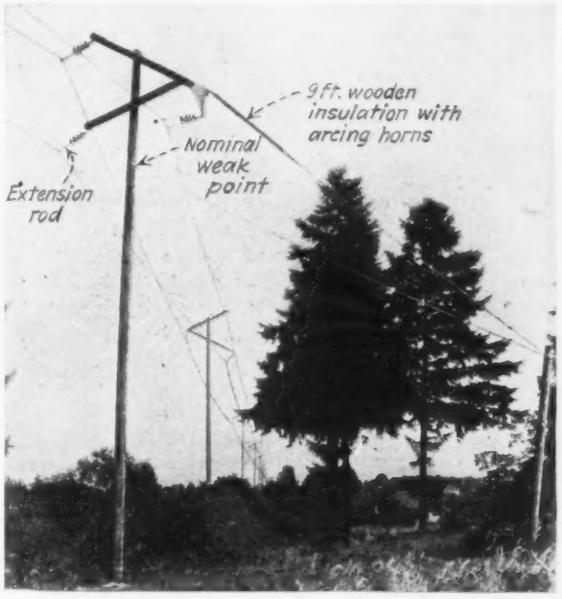
To guard against lightning and its effects heavy wood insulation has been provided. With a few exceptions, the supports of this line consist of H-frame structures with double 32-ft., 6x8-in. arms and wood-insulated guys. The few steel towers likewise have wood cross-arms. These arms were designed by the Byllesby Engineering & Management Corporation to meet the service conditions imposed upon them. Angle construction involves vertical corners with their characteristic economies of material and space.

Results thus far achieved in a period of severe lightning storms indicate unusually satisfactory performance of the line. Lightning arresters are only installed at substation points.

▼

Wishbone Construction and Arm Guys

Increased strength and a saving in pole height of 5 ft. were obtained by use of the wishbone construction here shown on a 66-kv. transmission line built by the Northwestern Electric Company in the city of Portland, Ore. Due to the use of 795,000-circ.mil ACSR conductor great care was required in designing supports with sufficient mechanical strength to provide a conductor spacing of 10 ft. and to withstand the sleet loads sometimes encountered in this territory.



Crossarm guy eliminates weak point in heavy line structure

Wishbone construction saves 5 ft. in pole height and provides equilateral triangular configuration. Typical tangent has 250-ft. spans.

The line is partially balanced mechanically by offsetting the arms to equalize the weight of conductors, and by guying to the end of arms as illustrated weak points at guy attachments are eliminated. By the combination of wooden poles and arms and 9-ft. wooden insulators in arm guys a line of the balanced impulse insulation type was obtained. To avoid cutting out slack when additional insulator units might later be added on angles and dead-ends for 110-kv. operation extension rods were used, as shown in the accompanying illustration.

Auger Makes Inverted Cone Hole

Tower footings frequently call for enlarged excavation at the base. The auger can be used successfully for this purpose by utilizing its tilting adjustment, according to Edwin Hansson, transmission engineer of the Pennsylvania Water & Power Company. The tendency for the auger to dig deeper can be prevented by throwing the lever into the lifting position and then slipping the clutch enough to maintain the level of the cutting tool at the desired point.

The same kind of use of the auger facilitates the blasting out of larger holes for heavy tower footings. Eight or more vertical holes are drilled around the periphery of the desired square. Five pounds of dynamite for a 9x9x11-ft. hole is then effective in removing most of the 33 cu.yd. of earth, at a cost of about 30 cents per yard for digging time.

In conjunction with normal excavation of pole holes a tubular shell of No. 16-gage steel about 6 ft. long and 22 in. in outside diameter is helpful in keeping earth from sloughing back into the hole after the auger has removed it. Flat iron bands at the top, bottom and middle stiffen the shell and rings facilitate lifting.

▼

Hinged Wooden Cross-Arm

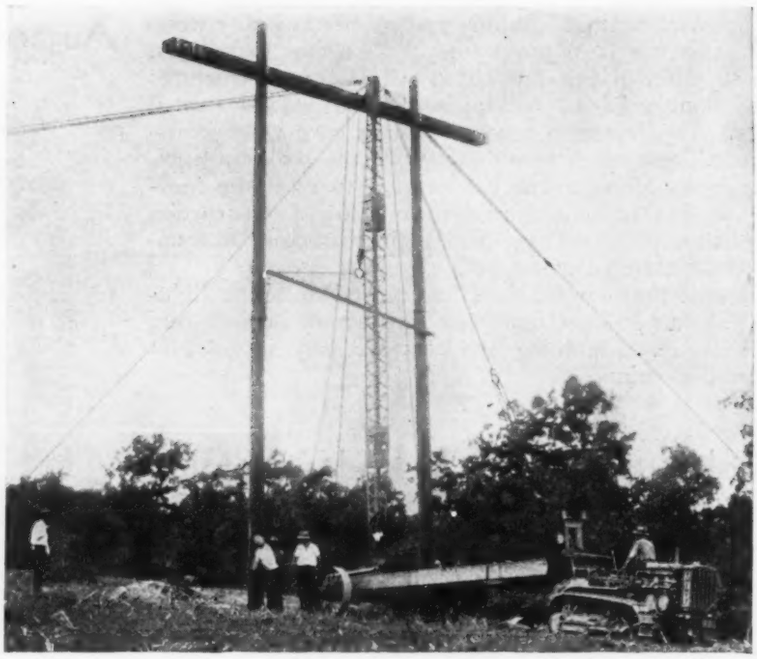
Reduced longitudinal leverage pull on tangent towers in case of a conductor break is achieved by special crossarm design for the 132-kv. line of the Union Electric Light & Power Company, St. Louis. Treated wooden arms are hinged at supporting points.

Courtesy Stone & Webster Engineering Corporation

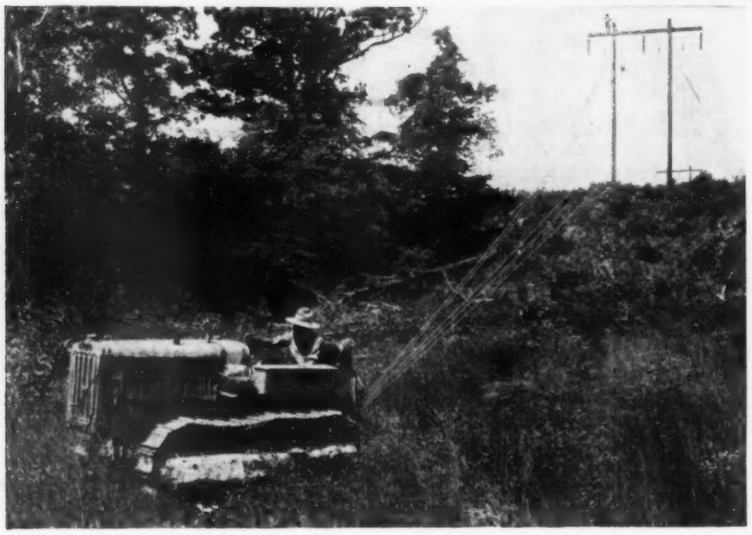
Tractors Speed Line Construction

IN THE erection of two 132-kv. transmission lines in connection with the Bagnell project of the Union Electric Light & Power Company, St. Louis, Mo., caterpillar type tractors played an important part and were utilized in a variety of ways beyond the scope of older methods.

These lines were located through rough, hilly country, covered about 60 per cent with second growth timber. The lines crossed very little farming land and there was a great deal of rock outcrop. Outside the state highways, the side roads were very poor, being rocky, crooked and not well maintained. After considerable study, it appeared that the caterpiller type of tractor was the only form of motive power available which could operate efficiently under all the conditions encountered.



Erection of 4-ton H-frame structure with derrick attached to caterpillar and hoist mounted on it

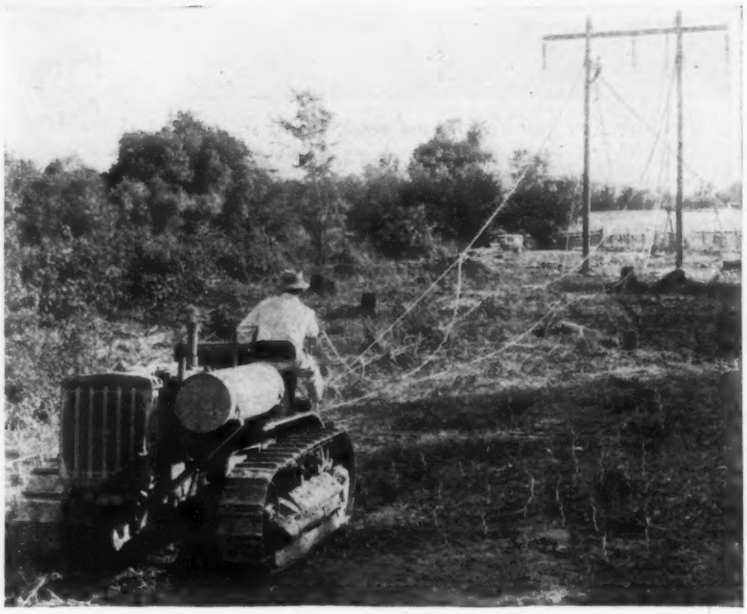


Stringing three conductors and two ground wires across rough country

In the construction of the wooden pole "H" structure line material was handled as follows: Poles and long crossarms were loaded upon a medium-sized truck and two-wheeled trailer. This truck hauled the timbers along the highway and as near as possible to the right-of-way. It was then unloaded and the timbers snaked to their proper location by a tractor. A derrick attached to another tractor was used in erecting the "H" frames complete. This tractor was equipped, on the rear end, with a single drum hoist, operated by the tractor engine. Through the hilly country this derrick-tractor rig erected from twenty to thirty structures per day, each weighing 3 to 4 tons.

In stringing wire the tractors were used to pull out the wire, move equipment ahead, and one equipped with a single drum hoist made the sagging of wire a very fast operation.

Two machines, weighing 4 and 5 tons each, of the wide gage type fitted for side-hill work, were used here. According to F. G. Dana, superintendent of construction Stone & Webster Corporation, the caterpillar type tractor is one of the most important and necessary pieces of equipment for the building of heavy-duty transmission lines.



Taking up tension with hoist mounted on rear of caterpillar

Wide Diversity of Opinion on Wooden Pole Lines

It is indicated that too many variables affect field experience to allow reaching definite conclusions regarding different practices unless efforts are made to compare only those results obtained under similar operating conditions and unless all comparisons are referred to some mutual standard. It is also shown that no element of any assembly can be discredited merely because the assembly fails inasmuch as this element may not have been used in proper combination with the rest of the assembly.

OPERATORS of several extensive transmission systems have been asked for comments on the relative service records of wood-supported and steel-supported transmission lines, their comparative over-all economies, the value of overhead ground wires and methods of grounding, experience with wood pins, braces and guy-wire inserts, and the relative vulnerability of wooden-pole construction to shattering by lightning. These operators were selected with the extent of their transmission experience in mind, and therefore their comments should mean something. But the wide diversity of replies makes it almost impossible to draw conclusions.

Do these divergences exist because they are merely opinions without substantiating proof? Because of the reputation and experience of the men making them, it seems hard to believe that the positive statements made in some cases could be uttered without facts to back them up. Even if they are mere opinions, they represent, at least, the attitude that is guiding these engineers.

It seems much more logical to believe that the differences of opinion are due to experiences under totally different conditions. The exposures of the lines to lightning differ greatly on each system and between companies, since the lines are scattered all over the United States. The types of construction compared in each case are not necessarily like those on other systems. Nor are the insulations of the lines compared necessarily the same.

Too many variable factors are involved to permit of precise comparison. If each could have based conclusions on experience with parallel lines of wooden and steel construction extending over diverse terrains, and if the clearances and insulation had been the same in each case, the conclusions might be more precise. But even then the lightning hazards in the various territories differ, and the constructions compared might not be the same.

Nevertheless, the comments are of interest as they explain the differences in practice and indicate the need of extending field investigations under more comparable conditions such that the variable factors which prevent precise conclusions could be reduced.

Apparently, the insulation value of wood has something more than theoretical value in preserving continuity of service, judging from the comments in favor of wooden construction. Still, there are comments upon steel construction by other companies just as commendatory.

While steel has greater permanence than wood and was once favored wherever the necessary appropriation could be obtained, some operators now say that steel structures become obsolete before they reach the end of their useful life. On the other hand, where circuit capacities must be very large, the voltage extremely high, or more than one circuit must be placed on the same structure, at least one company says that steel construction is dictated.

On both subjects—service reliability and over-all economy—however, the individual comments should be read to ascertain the conditions under which either wood or steel is recommended.

Despite all the investigations concerning the value of ground wires, there still seems to be divergence of opinion regarding their value on wooden poles. The cost of installing ground wires and securing effective grounds is repeatedly brought up, and in one case it is pointed out that the expense of ground wires may be sufficient to justify considering two circuits without ground wires over different rights-of-way. Great care is exercised by some to obtain low-resistance grounds, while others are satisfied with coiling the ground leads around the pole butts.

Although some companies have been inserting wood wherever it can be used to replace conducting mediums between phases or between phases and ground, others still favor metal pins and believe that wooden guy inserts should be avoided by attaching guys lower on the poles. Wooden cross-arm braces are favored by several of the companies.

Lightning does shatter wooden poles not protected by a groundwire and lightning rods, declares one company,

whereas another reports that shattering of poles equipped with ground wires has induced the discontinuance of these wires. Shattering of poles does not always interrupt service completely, because the conductors usually remain attached to the insulators and separated by the cross-arm even if suspended in mid-air. Particular attention is called to the segregated reply of one company which divides all its comments into two parts on the basis of whether high-voltage or low-voltage transmission lines are considered.

(Letters preceding each reply designate the same company when repeated.)

Do wooden-pole lines give more continuous service than equivalent steel-pole or tower lines because of better insulation?

B. Yes, provided that the same number of insulator units are used and that the insulator hardware on the wooden-pole lines is not grounded.

C. From our experience in this section of the country, would say that the steel-tower transmission lines give better service than wood. But our 44-kv. lines are insulated with seven standard suspension insulators on the steel-tower lines and with 45,000- to 66,000-volt pin insulators on the wood poles. It is possible that the later types of wooden-pole lines with wooden braces and guy insulators would equal or approach closer to the service of the tower line of this type.

If we compare the higher-voltage tower lines with the lower-voltage pole lines, perhaps the difference in the quality of service between the two would not be so great, as with the higher voltage on the line during the lightning storms there is more of a tendency for the power arc to follow a lightning discharge over the strings of insulators, although they may be somewhat longer than on the lower-voltage lines.

E. Our high-tension system is divided about equally between steel-tower lines and wooden-pole lines. From operating data it is hard to determine that either construction is more suitable than the other. In making this statement it should be borne in mind that all of our high-tension lines are equipped with grounded steel cross-arms.

F. I have concluded definitely that wooden construction affords much more opportunity to give continuous service than steel. It is definitely our experience that a well-designed all-wood line has a better record than a conventional tower line of the same voltage.

G. Lightning disturbances are responsible for the majority of our interruptions and these are 50 to 100 per cent more severe on our steel lines than on the wooden-pole lines.

I. Our only experience with the steel-tower line has been with one line about 35 miles in length, but, based on this limited experience, I would say that wooden-pole lines do not give any more continuous service because of better insulation†

K. Fortunately our steel-tower lines are in areas having very low ground resistance; consequently we have had exceptionally good performance out of them. They are also protected by static wires. However, in general, we believe that a properly constructed wooden-pole line will give better service than a steel-tower line.

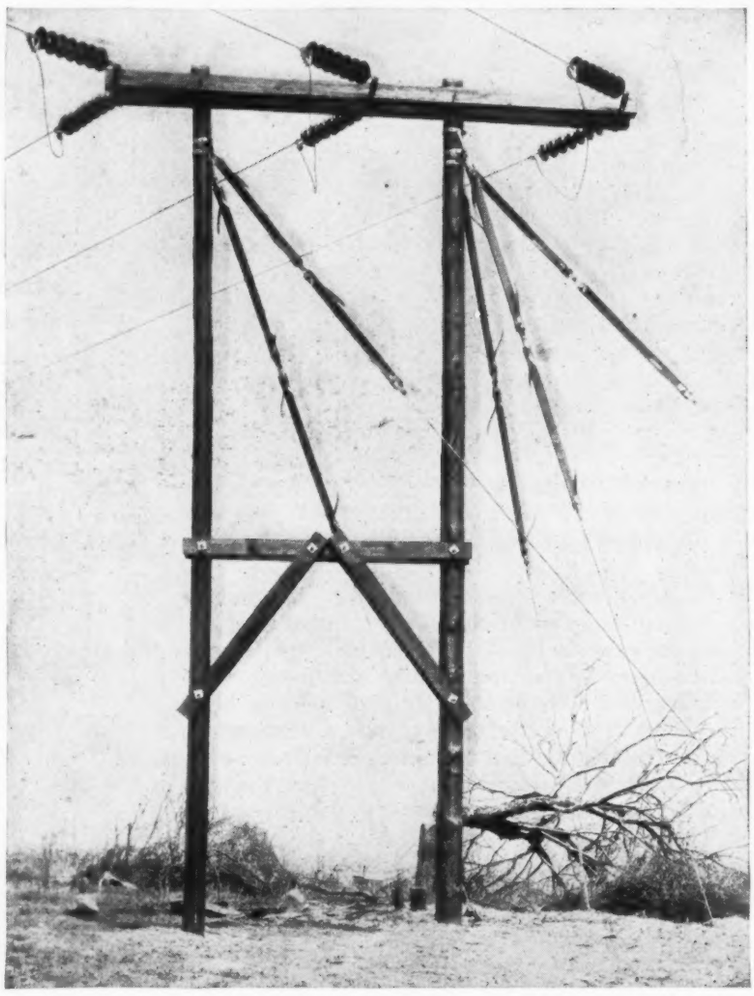
L. Yes.

M.—Other conditions being the same, lines which we have analyzed with higher insulation appear, on the average, to have somewhat fewer lightning tripous per line-mile than those with lower insulation. If insulation alone is the only protection against lightning, the difference in performance of lines for 66 kv. and above with different amounts of lightning insulation hardly seems sufficient to be a controlling factor in a choice between wood and steel construction.

With well-located overhead ground wires, there appears to be a marked advantage in utilizing the insulation strength of wood crossarms, protecting them against splitting if necessary with by-pass air gaps.

Unbonded wood construction is frequently advantageous from the standpoint of reducing the number of tripouts caused by birds. On the other hand, in many instances it is not practicable to utilize the wood, particularly the crossarms, on account of burning due to leakage current flow under conditions of contamination, fogs, etc.

N.—Wood-pole lines do not give more continuous service than "equivalent" steel-pole or tower lines.



60,000-volt wooden-pole line with wood crossarms and guy inserts on duplicate line between Alabama Junction and Akron on Niagara-Hudson system

†I. Two conditions influence this experience and may so modify the conclusions as to make them entirely inapplicable to the eastern part of the United States. The first is that there is relatively very little lightning in this locality. The weather reports show an average of 8.7 lightning storms per year during the last 43 years. My own observation during the last few years is that there are an average of about two lightning storms per year in each district covered by this company which are severe enough to cause trouble on the transmission lines. The second condition is that most of the districts covered by this system are very dry during the lightning season, and the soil conditions are such that it is not possible to get low-resistance grounds without taking particular pains to select suitable locations for the grounds and the use of multiple rods treated with salt.

Is a good wooden-pole line equal to any other construction for major transmission lines in regard to cost, reliability, life and maintenance?

A. In our opinion, a properly designed wooden-pole line is at this time far superior to any other construction from the standpoint of economy and reliability.‖

B. Yes, all things being considered, we consider a good wooden-pole line equal to any other construction for major transmission lines, excepting, perhaps, in very inaccessible country, where long spans are necessary, or near cities, where permanence and high factors of safety are desirable.

C. We do not believe that a wooden-pole line is equal to a steel-tower line for major transmission lines in so far as reliability, life and maintenance are concerned. The wooden-pole line can, of course, be built at a lower cost, and this is perhaps its principal virtue.

For use on transmission lines connecting generating stations having capacities of 100,000 kw. per circuit we do not think the wooden-pole line equal to the steel-tower line. For loads of less importance and representing less income wood lines may be justified.

E. Our wooden-pole lines are as reliable as tower lines, and, of course, the initial cost is somewhat less. On the other hand, when the cost of these lines, including interest charges, maintenance, depreciation, etc., is compared with that of steel-tower lines, we find that there is very little difference for lines of comparable design, and naturally we lean toward the use of steel, which, of course, has a much longer life and has structures which are much easier to maintain. On important lines it becomes more difficult to remove the line from service for necessary structure maintenance, and a wooden-pole line is likely to reach its greatest usefulness at a period when its strength is greatly affected by depreciation and major repairs are necessary.¶

F. Yes.

G. On the assumption that a wooden-pole line has an average life of approximately ten or twelve years, as against twenty-five or thirty years for a steel-tower line, the question of replacement must enter the argument. Theoretically we would have three periods of general interruptions for wood against one for steel, during replacement, and three times the replacement cost. Practically, however, it is my opinion that the development in the art of transmission and the improvement in transmission facilities are such that a steel line will become obsolete before the thirty-year period, and taking into consideration the difference in cost of original construction, of wood as compared with steel, the replacement costs will be about equal. We realize now that some of our steel lines (44 kv. and under) are virtually obsolete, although the necessity for renewal from deterioration has not yet occurred.

I personally believe that for voltages up to and including 44 kv. the wooden-pole construction is preferable and the original cost of steel construction not justified. For 132 kv., however, where the construction is of a much heavier type and additional mechanical strength necessary, steel construction is more desirable. These lines are usually of major importance and the additional expense is warranted.

H. We feel that where single-circuit lines are required for a given service, the maximum reliability can be obtained at a minimum annual cost by the use of wooden construction. Where double-circuit lines are necessary, however, it is probable that the double-circuit steel-tower construction is preferable.

I. In this district, which is at the source of supply of cedar poles, the cost of wooden-pole lines is much less than that of equivalent steel-tower lines. The reliability is, I believe, equal; the life is naturally shorter by perhaps one-half, and the maintenance is about equal when pentrex treated poles are used.

J. Yes.

K. We believe a properly constructed wooden-pole line is equal to any other construction for major transmission lines in regard to cost, reliability, life and maintenance.

L. I believe that a good wooden-pole line is better than any other construction for major transmission lines, taking into account cost, reliability, life and maintenance.

M. For some types of lines wood construction has distinct advantages over steel, the principal ones being lower capital cost, lower annual cost and the value of the wood as supplementary insulation. These advantages are more pronounced in the lower voltage classes, where obsolescence of the lines is proportionately greater. The usefulness of trunk transmission lines over long periods of years along with other factors, such as right-of-way limitations and the desirability of double-circuit construction, frequently justify the steel tower construction. As a rule the insulating value of the wood in transmission structures is not a deciding factor in the choice between wood and steel construction.

N.—For single-circuit line I believe that a wood-pole line can be constructed to perform, everything considered, as well as a properly designed steel-tower line.

Are ground wires justified on wooden-pole lines with grounding at each pole? If so, what precautions must be taken in regard to size of ground wire, pole-ground wire and maintenance of pole ground?

A. Whether overhead ground wires are justified on wooden-pole lines is, of course, a question of the cost of the ground wire in the position necessary to do real good, plus the cost of securing low-resistance grounds. With a requirement for ground wires 25 ft. to 35 ft. above the conductor and a 5-10-ohm ground resistance it is not inconceivable that the cost of the line may be greatly increased, even to a point where a second line by a separate route should receive serious consideration.

B. Yes, especially on lines of 66 kv. and above. On less important lines below 66 kv. it is often difficult to justify the extra expense of ground wires. The ground wire might just as well be grounded at each pole. We suggest a ground wire not less than the equivalent of ⅜-in. steel and a pole ground wire of No. 4 copper. Ordinarily, if the No. 4 copper ground wire is wound around the butt of the pole, it requires no maintenance.

C. We do not make a practice of installing ground wires on wooden-pole transmission lines, believing that the wooden insulation of the pole is of more value than the ground wire. In mentioning wooden-pole lines I am referring to lines up to 66 kv. If we were to install a ground wire, I believe it would be grounded at each pole and every precaution taken to make sure a good ground was secured. On some tower lines we have driven pipe to a depth of over 100 ft. in order to make sure of a low-resistance ground.

D. Interruptions and maintenance due to ground wires do not appear to justify their use in our district on wood lines.

E. We believe that overhead ground wires are justified on every important line and that they should be grounded at every structure. We have found that the best type of ground is ordinary ⅜-in. steel guy wire, which is not subject to burning or theft. When ground wire is coiled on the butt of the pole virtually no maintenance is ever necessary.

F. My present feeling is against the use of ground wires on wooden-pole lines. We recently placed in service a 24-mile section of line which we regard as our most important. It connects our new station with the system. This line consists of two parallel H-frames on the same right-of-way. There are no horizontal ground wires, we preferring to get the highest possible insulation (that is, impulse strength) and take chances of some pole shattering—the guiding principle being that one of the two circuits must always stay in. This line has gone through the present summer, which has been a very bad one as regards lightning, performing just as we want it to. Since we have set our relays properly there have been no cases of both lines tripping out simultaneously, although one or the other has been out several times. There has been no pole damage. Wooden strain insulators were used in the guys.

One important objection to the use of ground wires on H-frame lines is the difficulty in so guying the structures that the pole will not be overstressed from the top down to the point of guy attachment. To attach the guy at all close to the point of application of the load results, owing to the ground wire, in inadequate clearance for the conductor. In our rolling country, should we

‖A. Operates no transmission lines on steel towers.

¶E. Concerning the use of wood as an insulator on transmission lines, we have not had very much experience with this type of construction to date. We are, however, now equipping an experimental line. Please bear in mind that we have no conclusive data to offer either one way or another, and that the answers are purely theoretical.

§G. On this system practically all lines above 44-kv. are on steel towers and practically all 44-kv. lines are on wooden poles. Most of the tower lines have been erected in the past six years, while many of the wooden-pole lines have been in service from twelve to eighteen years. At the time of actual construction of the older wooden-pole lines electrical and mechanical design features were sacrificed to some extent in the interest of economy, and these lines do not equal the high standard of construction we have been using for the past six or eight years. It is therefore rather difficult to get a good comparison.

use ground wires on H-frames, we would have nearly every structure guyed in order to get the span lengths that we want.

G. Nearly all of our wooden-pole lines are equipped with overhead ground wires, and we do not have sufficient pole mileage without ground wires to give us a real comparison on its operation. We have now equipped all of our major steel lines with overhead ground wires and have a noticeable reduction in the number of outages from lightning disturbances. Our records show that on 132-kv. steel-tower lines originally constructed without ground wires our interruptions from lightning have been reduced as much as 50 per cent since ground wires were installed. We had one 88-kv. line on wooden poles, 49 miles long, with a ground wire installed on the first section of 21 miles. This line ran through somewhat similar territory for its entire length, and we actually found that we had less lightning disturbance on the 28-mile unprotected section than we had on the 21-mile section with ground wire. After about five years' operation we removed the overhead ground wire on this 21-mile section (on account of deterioration in the material), but as there was practically no change in the ratio of lightning interruptions.

We ran a ground wire down each structure on our wooden-pole lines, but in our territory the value of the actual grounding we get is questionable. In the majority of cases our structures are set in rock. We have not made many complete tests of our wooden-pole line grounds, but actual tests of our tower lines show that the majority of them have very high resistance.

Our present practice is to install an overhead ground wire either of the same size as the conductors or of the same mechanical strength. Where we use steel-cored aluminum for conductors on our major transmission lines, we have in a number of cases cut down on the amount of aluminum in the ground wire and increased the amount of steel to get the same mechanical balance with less cross-section.

I. During the last three or four years experience has been had with 110-kv. lines of similar construction, some with two overhead ground wires and some with none. The experience has been that the use of the overhead ground wires is not justified.

J. We believe that the ground wires are justified, retaining the insulation of the wooden arm and gaining the direct-stroke protection of the overhead ground wire. The ground wire should be at least as strong as the conductor.

We carry ground wire on our poles for about a mile out of the substation, so it is rather difficult to be sure where our trip-outs occur. We do, however, know definitely that one line has flashed over twice in the section in which there is no ground wire installed, that section being protected with down wires with gaps.

K. We believe ground wires are justified on wooden-pole lines with grounding at each pole. The ground wire should be of ample size to take care of protection against fusing during the short time between the instant of a flashover and the time the oil circuit breakers trip out. Our standard is No. 4 copper or "Copperweld." Pole grounds are measured during the dry season of the

Differentiation Made Between High-Voltage and Low-Voltage Lines

One company, in expressing its views, makes a dividing line of 66 kv. The wooden-pole lines considered are all-wood construction, i.e., wooden cross-arms, insulation in guys and adequate separation between phases in the form of wooden supports.

Interruptions on its 132-kv. system (steel towers) due to lightning have averaged over a period of years slightly more than one per 100 miles per year. On the conventional 33-kv. wooden-pole construction, using steel braces and uninsulated guys, the interruptions have averaged about 40 per 100 miles per year. In the latter part of 1929 it standardized on the use of all-wood construction for the 33,000-volt system, and it has at the present time about 176 miles in service. The indications to date, based on a careful follow-up of all locations showing evidence of lightning, are that the all-wood construction is free from interruptions due to this cause.

33-Kv. Lines

Wooden-pole lines will give much more continuous service than steel lines. It is probable, however, that a 33-kv. steel line with insulation of the order of that ordinarily used for 132-kv. lines would give about as satisfactory results with respect to lightning performance as the all-wood line. The essential point in design appears to be that of securing sufficient separation between conductor and ground by the use of either wood or porcelain insulation to prevent the formation or sustaining of dynamic arcs following lightning sparkovers.

Our practice is to use wooden-pole construction exclusively on the 33-kv. system, except in certain special situations where structural requirements and height, stability, etc., make steel construction more practicable. We believe the wooden-pole construction to be the equal of any other construction in regard to all-over considerations.

Ground wires are not justified on wooden-pole lines.

Wooden cross-arm braces and insulation in the guy wires are justified. We obtain satisfactory performance with steel pins and therefore do not think wooden pins are necessary.

We have a few poles shattered by lightning, but were steel poles or towers used with the conventional insulation for 33-kv. lines, the trouble due to insulator flashovers and to wires burning down would, in our opinion, more than counterbalance a few shattered poles. Serious structure damage due to pole shattering appears to be of the order of three cases per 100 miles of line and is not materially different on the all-wood construction from what it is on the conventional type of construction. In addition to serious cases, there is considerable minor splintering of poles and cross-arms which does not require repair.

132-Kv. Lines

We believe that steel-tower lines will give more continuous service than wooden-pole lines because of the smaller amount of maintenance required and for the reason that wooden-pole lines of this voltage should be equipped with overhead ground wires, which, in effect, will give grounded structure operation similar to that obtained by steel towers. However, it is also our opinion that for lines somewhat less in capacity than is required in this district wooden-pole construction should give economical and satisfactory service.

We favor steel-tower lines for this voltage.

I do not believe that a wooden-pole line at this voltage can be operated satisfactorily without ground wires and grounding at each pole. The ground should be rather low (approximately 5 ohms or less) and the ground wire and pole ground should be rather large. We use nothing smaller than No. 3/0 A.C.S.R. for ground wires.

One hundred and thirty-two kilovolt wooden-pole lines could advantageously make use of wooden braces in order to provide as much insulation as possible between the line and grounded pole structures (assuming that overhead ground wire is used). Guy-wire insulators would not be of use on the grounded pole structure.

Shattering of poles by lightning would not be a problem with the overhead ground wire which we believe should be used.

year, and an attempt is made to make each ground come below 25 ohms.

L. It is my opinion that overhead ground wires on wooden-pole lines are not generally justified where each pole is grounded. A large part of the trouble that we have had with overhead ground wires has been mechanical and due to insufficient care being given to the method of attaching the overhead ground wires. Most of our pole ground wires are of No. 6 EBB galvanized iron. Personally, I believe the pole ground wire should be of copper or copperclad and should be not smaller than No. 6 AWG.

M. Overhead ground wires would not be justified on all lines even if they provided complete freedom from line tripouts. Our analyses indicate that overhead ground wires as generally installed on wooden-pole lines decrease the number of line tripouts by a considerable amount. However, their effectiveness is increased with higher insulation between the phase wires and ground, with increased height of overhead ground wires, with close spacing between grounded points for the overhead ground wires and with low resistance grounds. The size and material of overhead ground wires and pole grounding wires appear to have relatively less bearing than the above factors on the line performance.

N. Ground wires are justified and/or may be necessary to provide wooden-pole lines with satisfactory operating characteristics. Grounding provisions must be made just as carefully as on steel-tower lines. As to size of ground wires and pole ground wire, I think much is to be learned before definite statements can be made.

Does lightning shatter poles and cause a relatively longer time delay in maintenance than occurs with steel-pole or tower lines?

A. A long period of operating experience with wooden-pole lines has convinced us that it is an exceedingly rare case for a pole to be damaged sufficiently to cause a long outage on a line. However, such shattering of poles as takes place of course reduces their life and makes earlier replacements necessary.

B. Yes, lightning occasionally shatters poles without pole grounds, but these occurrences are not frequent enough to be a serious problem.

C. Lightning does shatter poles that are not protected with a ground wire or lightning rod. This is perhaps the principal consideration in deciding on the use of a ground wire on wooden-pole lines. We have a steel-pole line insulated with pin-type insulators similar to those on the wooden-pole lines and operating without ground wire. The damage on this steel-pole line I believe is as great as on the wooden-pole line, as the shattering of the poles does not always cause the permanent failure of the line. Very often when the pole is very badly shattered or almost blown out from under the line the cross-arm with its pins and insulators may remain intact, hanging to the line.

D. We have not experienced any trouble with lightning shattering wooden poles carrying conductors.

E. We have relatively little trouble with lightning shattering wooden poles, possibly because of the fact that most of our poles are grounded. Except in the case of a power arc hard enough to burn off the conductors, we seldom have more than momentary interruptions from lightning.

F. We have relatively little pole shattering. It is this experience that contributed to the justification for discontinuing use of ground wires. Our most recent case of pole shattering was in a line protected by ground wires; this particular pole did not have a vertical ground lead on it.

G. We have not suffered severely from having poles shattered by lightning, and in very few cases has this seriously affected continuity of service. A shattered pole top often saves the cross-arm and insulators, whereas a direct stroke on a steel line will usually clear off all of the insulator units. Practically there is very little difference in the time involved in making changes.

I. Some shattering of poles and cross-arms has been experienced, but in a large percentage of the cases the line has gone back in and operated until such time as it was convenient to shut down the line for repairs.

J. Thus far we have had no poles shattered. Thus far, with 90 miles of line in service, we have had one guy strain shattered and one damaged, probably by lightning. We have lost one cross-arm, definitely by lightning, and one probably by lightning.

K. Our experience has been that lightning shattering poles causes a relatively longer time delay in maintenance than when lightning strokes occur on our steel-tower lines.

M. Unprotected wooden poles, crossarms or guy insulators will be shattered by lightning flashovers, and as a rule where lightning is prevalent the operating difficulties and cost of maintenance will justify protective measures. If the wood is completely bonded and grounded the lightning performance will be equivalent to steel construction with similar insulation, configuration and clearances.

N. Lightning will shatter poles and crossarms without ground wire, thus causing line outages of much longer duration than are experienced on steel-tower lines.

Are wooden pins, braces and guy-wire inserts justified?

A. We seriously question the justification for the installation of wooden braces and guys *per se*. If properly co-ordinated, with some effective scheme for discharging the lightning current without 60-cycle follow up, they appear to have a place in the design.

B. In general, wooden braces are justified, but wooden pins are not. Wooden guy-wire inserts can usually be avoided by installing guys a little lower on the poles.

C. In the past we have used wooden pins on practically all of our wooden-pole transmission lines. However, we discontinued this practice two or three years ago, and on all new lines and any reconstruction we are using steel pins. The wooden pins were satisfactory for a number of years, but unless watched very carefully were apt to burn off and cause trouble, and inasmuch as a wooden pin does not improve conditions electrically around the insulators—in fact, conditions are better with a steel pin—we believe that outside of cheapness there is no value in using the wooden pin. We think quite well of wooden crossarm braces and are using them on all new lines. Undoubtedly, the wooden braces will greatly improve conditions in so far as phase-to-phase short circuits are concerned.

E. Our standard practice is to use metal pins, even on distribution lines. On an experimental line that we have built we plan to eliminate entirely the crossarm braces, and to put wooden inserts in the guy wire. On this line an overhead ground wire will be carried on the pole at a point several feet below the conductors, and the wooden insert will be designed to develop the insulation in the pole itself.

F. In rebuilding a 44,000-volt strain wishbone line (which had a ground wire on bayonets) we used suspension insulator construction, wooden arms, wooden braces and wooden insulators in the guys. We do not use wooden pins on voltages greater than 6,600.

G. In my opinion the wooden-pole line offers greater insulation qualities, and while a great many companies are now going to the use of wooden pins, wooden crossarms and wooden braces to obtain the additional insulation value on their structures, our company has not yet gone into this type of construction to any extent. In my conversations with representatives of other operating companies the majority assert that they are getting much better operation at present from this new type of construction, but most of them agree that they have not had it in service long enough to give an absolute opinion on its value. They agree that they have reduced the total number of outages for the first couple of years, but are open to doubt as to whether or not they will get a greater percentage of outages from this construction when deterioration has reached a noticeable point than they otherwise would have experienced. The future cost and difficulties of replacement at a time when the lines are loaded and interruptions will be more serious may prove that this type of construction was not justified originally.

H. The construction which we have adopted uses suspension insulators, wooden arms, wooden strain insulators in the guys and no ground wires. We are trying to keep the number of bolts through the poles at a minimum to reduce the likelihood of poles shattering.

I. Wooden pins, wooden braces and wooden guy wire inserts, in my opinion, are not justified.

K. We believe guy-wire inserts are justified in some cases. We have had no experience with wooden braces.

L. Yes.

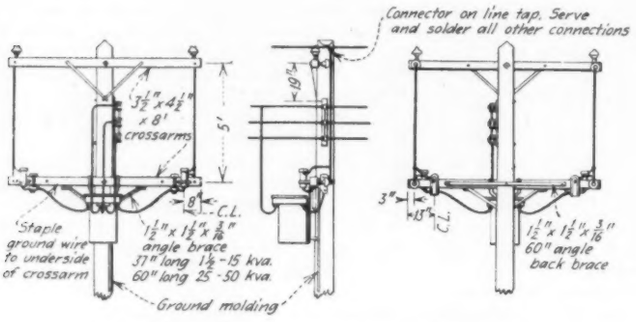
M. Wooden pins, braces and guy insulators all contribute toward increasing the insulation against lightning, but are subject to damage from lightning flashovers, also burning, if no protection is provided.

N. Wooden pins do not seem justified, wooden braces and wooden guy wire inserts may be justified and/or may be necessary to obtain a line with satisfactory operating characteristics.

Strength and Simplicity in a Pole-Type Transformer Station

As a result of study to standardize upon one particular design for a single-phase pole-type station that would meet the majority of requirements and which would combine as many good features of prevalent designs as possible, the Central Ohio Light & Power Company is reported by L. M. Grow to have devised a layout representing the most desirable combination of materials that would economicallly give adequate and permanent strength, a maximum degree of safety, simplicity and ease of construction and a neat and finished appearance.

The station is built on standard 8-ft. crossarms, only one arm being used for mounting all equipment instead


Connector on line tap. Serve and solder all other connections
3½" x 4½" x 8' crossarms
5'
8"
C.L.
18"
3"
15°
C.L.
'Staple ground wire to underside of crossarm
1½" x 1½" x 3/16" angle brace 37" long 1½-15 kva. 60" long 25-50 kva.
Ground molding
1½" x 1½" x 3/16" 60" angle back brace

Steel angle back brace permits use of one crossarm in place of two

of two or three as sometimes used. To give the main or transformer arm sufficient strength in a horizontal direction, an angle back brace is used. This provides a much stiffer arm, which is simpler and more economical than a set of double arms. For vertical strength, an angle crossarm brace is used instead of the usual flat braces. In place of the customary small wooden arm or wooden block for the transformer kick-off, galvanized steel kick arms are used, these being bolted to the trans-

Material List

Former Design

3½x4½-in. x 5-ft. 7-in. crossarms	3 at $0.90	$2.70
3½x4½x38-in. crossarms	1 at 0.55	0.55
28-in. flat braces	6 at 0.39	0.54
⅝-in. through bolts	3 at 0.09	0.27
⅝-in. D.A. bolts	2 at 0.11	0.22
½-in. carriage bolts	6 at 0.025	0.15
⅜-in. lags	3 at 0.03	0.09
2¼-in. square washers	14 at 0.015	0.21
Total		$4.73

New Design

3½x4½-in. x 8-ft. 0-in. crossarms	2 at $1.20	$2.40
Galvanized steel kick arm	1 at 0.35	0.35
28-in. flat braces	2 at 0.09	0.18
⅝ in. through bolts	2 at 0.09	0.18
½-in. machine bolts	2 at 0.035	0.07
½-in. carriage bolts	4 at 0.025	0.10
⅜-in. lags	2 at 0.03	0.06
2¼-in. square washers	3 at 0.015	0.05
1¼x38-in. angle brace	1 at 0.40	0.40
1¼x5-ft. 0-in. angle back brace	1 at 0.52	0.52
Total		$4.31

Decrease $0.42 or 8.9 per cent.

former while it is on the ground. Distribution racks are employed in practically all cases, although wooden crossarms may be necessary where clearances are limited.

The lightning arrester ground wire is stapled to the underside of the crossarm, the crossarm thus serving much the same purpose as the ground wire molding in shielding the ground wire from accidental contact. Standard wooden molding covers the ground wire for its entire length along the pole. Electrical clearances are entirely adequate at all points and no leads are long or flexible enough normally to come in contact with other parts. Working clearances are unusually large, thus providing more than the ordinary amount of safety to the lineman.

As well as providing a stronger and safer construction, a decrease in the cost of equivalent material of approximately 9 per cent results from the newer design. This is shown in the accompanying lists of material for the new design and for the former type of construction, the latter using double four-pin arms for mounting the equipment. Material such as the pole, insulators, cutouts, etc., which are common to both designs, and the item of labor, which is approximately equal for either design, are not included in the lists.

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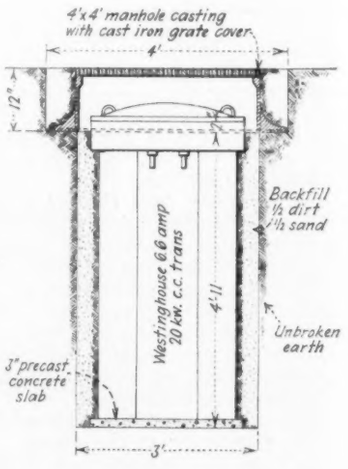
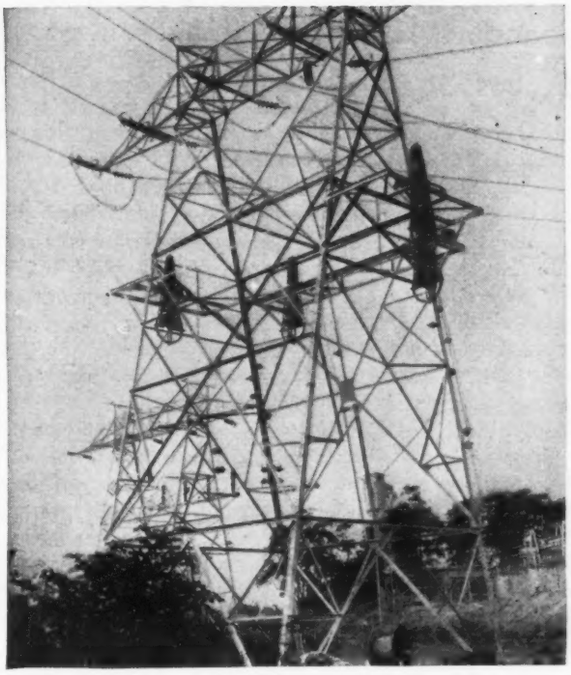
Lighting and Distribution Transformers for Suburban Areas Set in Earth

Standard underground transformers are being set directly in the earth by the Philadelphia Electric Company. This practice is being followed with constant-current transformers in suburban and park areas, especially where no ready means are available for mounting the transformers on poles. Distribution transformers are also being set directly in earth, one installation consisting of two 37½-kva. and two 15-kva. transformers set about 3 ft. apart.



The hole is so excavated as to necessitate a minimum of backfill, which is made half earth and half sand. The lead-covered primary and secondary leads are buried in the backfill. A manhole casting is set on a shelf in the excavation so as to bring its lower edge below the joint at the transformer cover and thus guard against earth rolling into the oil when the transformer cover is removed for inspection or repairs. If the windings fail, the core is removed and a new one installed without removing the case from its earth setting. In cases where it is necessary to insure the level on the manhole cover the rods bolt the frame to the concrete slab on which the transformer rests. Fuses are mounted on the nearest pole.

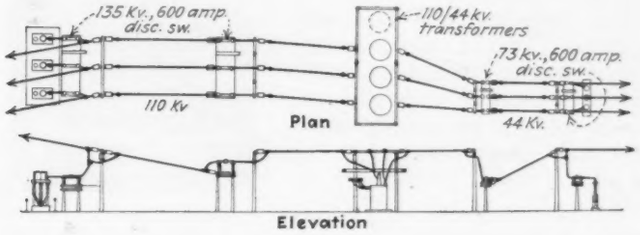


Accessible Mounting of Condenser Couplings

At the Cabot switching station of the Turners Falls Power & Electric Company condenser couplings for carrier-current telephone service are conveniently mounted and symmetrically grouped on an angle tower carrying two 110-kv. circuits as shown in this view taken during construction. Three structural-steel bracket platforms projecting on three sides of the tower carry the four couplings and their oil reservoirs well above the ground and clear from the climbing leg. The carrier-current circuits are run on 15-kv. pin type insulators attached to the power members, and the tuning box is located near the bottom of the tower. On the 69-kv. line in the background are mica-type couplings for carrier service.

A Step-down Substation Without Circuit Breakers

Wausau, Wis., is the eastern terminus of a 110-kv. line through which connection is made between the systems of the Wisconsin Valley Electric Company and the Northern States Power Company. It is not possible to bring the high voltage into the city limits and therefore the line is stepped down to 44 kv. just outside. Normally a 110/44-kv. station would have oil breakers on both sides of the transformers. But this is a straight through station without any taps or local service and in effect it was treated simply as a part of the line. Disconnects



were used as shown, but 110- and 44-kv. oil circuit breakers were entirely omitted. The line is relayed at both ends and the transformers are protected by lightning arresters on both sides.

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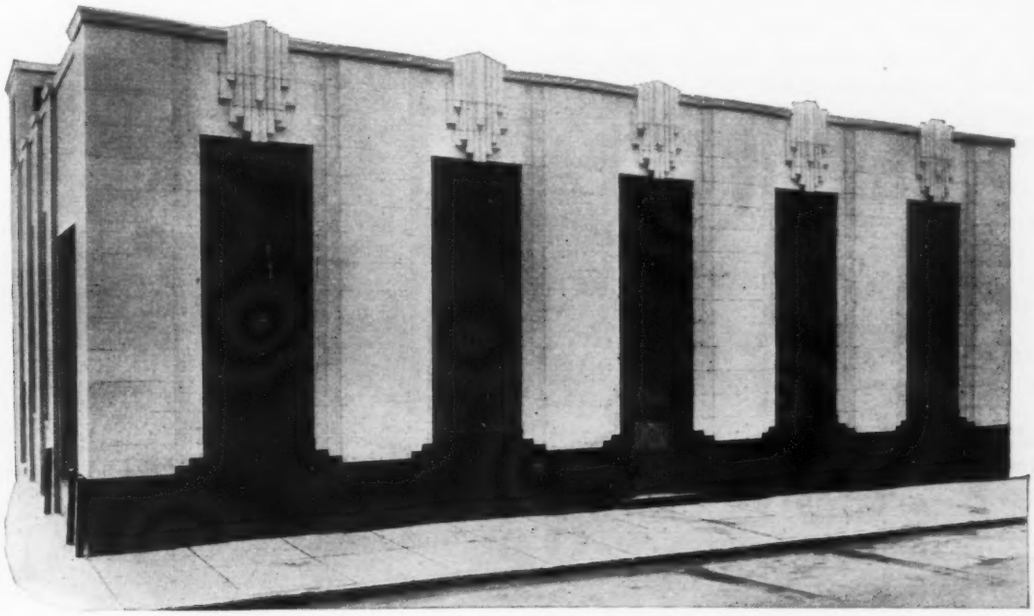
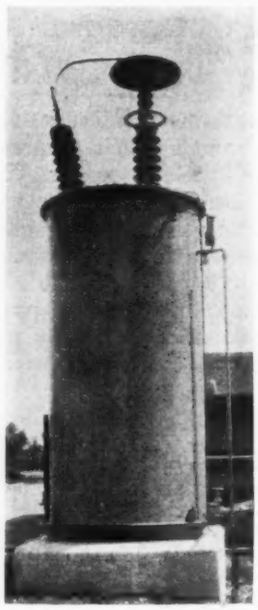
A Substation That Contributes to Its Surroundings

Probably there will never be developed an architectural style peculiarly and distinctively that of an electric system substation. However, this exterior of the new Fifteenth Street substation of the Union Electric Light & Power Company, St. Louis, designed by Klipstein & Rathmann, is unusual without being labored or ornate, and is surpasses in appearance most of the structures surrounding it.



Reactor and Lightning Arrester Combined

The cost of one lightning arrester in the 132-kv. substation at the Harding Street station of the Indianapolis Power & Light Company was considerably diminished from like installations in the same substation. It was done by mounting the neutral bus arrester on the case of the reactor between this bus and ground. This arrester is somewhat smaller than the others in the substation since it needs to be rated at phase to ground pressure, about 75 kv.



What a Well-Built Substation May Be

Representative of the best and most recent of today's electrical engineering practices, and including in its design not only features of economy, reliability, safety and ease of operation but also attractive appearance, the Zanesville (Ohio) substation of the Ohio Power Company, a subsidiary of the American Gas & Electric Company, is an interesting example of co-ordinated effort and thinking.

This 132/22-kv. transforming and distributing center receives energy from taps to the two Philo-Crooksville transmission lines and distributes it to three primary substations in the Zanesville area.

Notable equipment features include the latest type of thyrite lightning arresters, shown to left of the structure, for supporting the incoming lines; carrier-current condensers and current transformers in the bushings of the high-tension oil circuit breakers, rotating buses, latest type of forced air cooling of oil-insulated and oil-cooled transformers, oil purifying through the use of flexible couplings to underground lines strategically placed, and well-planned yard lighting.

The advantages realized in this design involve minimized insulator requirements, high efficiencies, good yard operating conditions, attractive appearance, reliability and provisions for future expansion at minimum cost. Note also the concrete walkways, the well-graveled yard and the open spacing contrived without undue use of ground area.

According to Philip Sporn, chief electrical engineer American Gas & Electric Company, this station, for all its advanced and attractive features, cost no more than preceding designs which did not possess these advantages. The capacity of the station is approximately 28,500 kva., provided by two transformer banks. A 15,000-kva. bank delivers 22,500 kw. under forced-air circulation, and the second bank of self-cooled transformers is rated at 6,000 kva.

Grounding Transformer Bank Supplies Station Energy

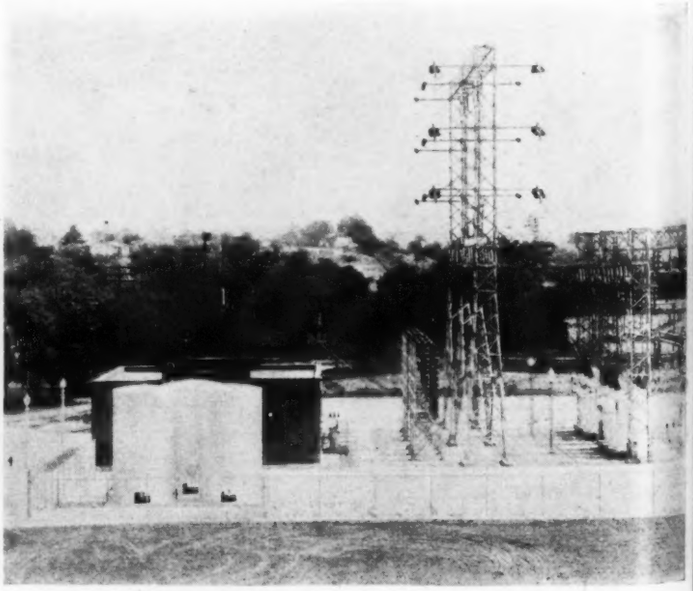
To serve as a spare source of energy for station service equipment, a 2,000-kva., 33,000/13,200/2,300-volt grounding transformer bank has been provided with a third winding for full-capacity output of 2,300 volts at the Gilbert station of the Associated Gas & Electric System at Holland, N. J.

As stated by E. D. Sibley, superintendent of power supply Utility Management Corporation, New York, this capacity is not sufficient to carry all of the station service load under full plant output conditions, but is sufficient to carry the auxiliaries of the plant during shutdown and starting periods. It also provides energy for station service with main bank out, permits repairs on the main bank and permits the main bank to be shut down when not needed without shutting down station service.

In view of the fact that the modern transformer is a very reliable piece of apparatus, especially where it is shielded from lightning disturbances and at the low operating voltage of this service, it was decided that the main station service bank of 7,500-kva. capacity, energized from the generator low-tension bus, would give sufficient reliability during plant operation. This station service reliability is further insured by making this main station service bank large enough to carry the auxiliaries of the entire plant at full output when connected in open delta.

An inspection of the single-line diagram reveals that the location of this station service bank is such that energy is derived through the main power bank of 60,000-kva. capacity during periods of plant shutdown and that the energizing losses of this power bank would be added to the small station service load unless this bank was required for tying the 110-kv. system to the 33-kv. system. It also shows that in case of repairs to the main power bank the generating equipment of the

Zanesville substation



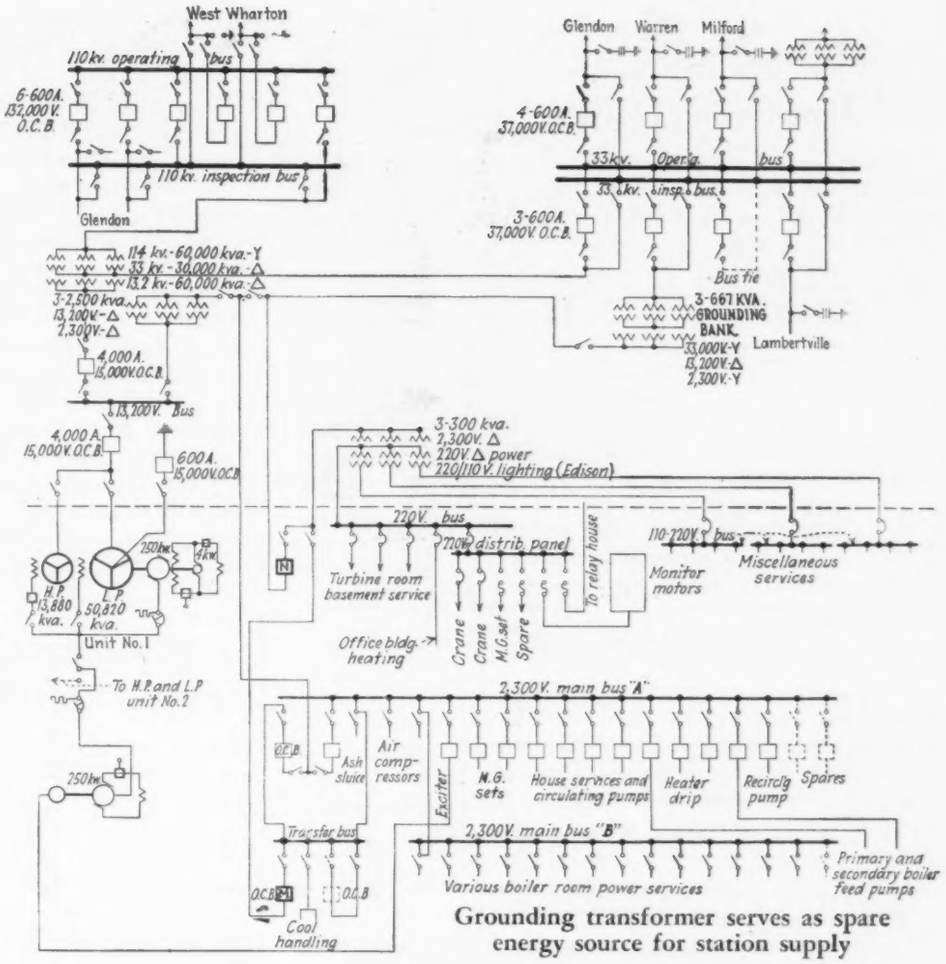
plant would be required to operate in order to furnish energy for station lighting and small power were there no spare source of station service feed.

A suitable source at minimum cost was secured by obtaining a grounding bank for the 33,000-volt system with a third 2,300-volt winding of full capacity. This bank was necessary for system operation and protection, and the cost for the third winding added to the price of the required two-winding bank was small in comparison with the cost of installing a separate bank.

This grounding bank serves also as an emergency lighting and small power source through oil circuit breakers *M* and *N*, which are interlocked so that the closing of either breaker will immediately trip out the other. This arrangement will allow the repair of either breaker without interruption of service. A separate source of emergency lighting is obtained from the station batteries, which operate immediately in case of failure of alternating-current lighting energy, and this source is backed up by the grounding bank so that needless drain on the station battery may be eliminated.

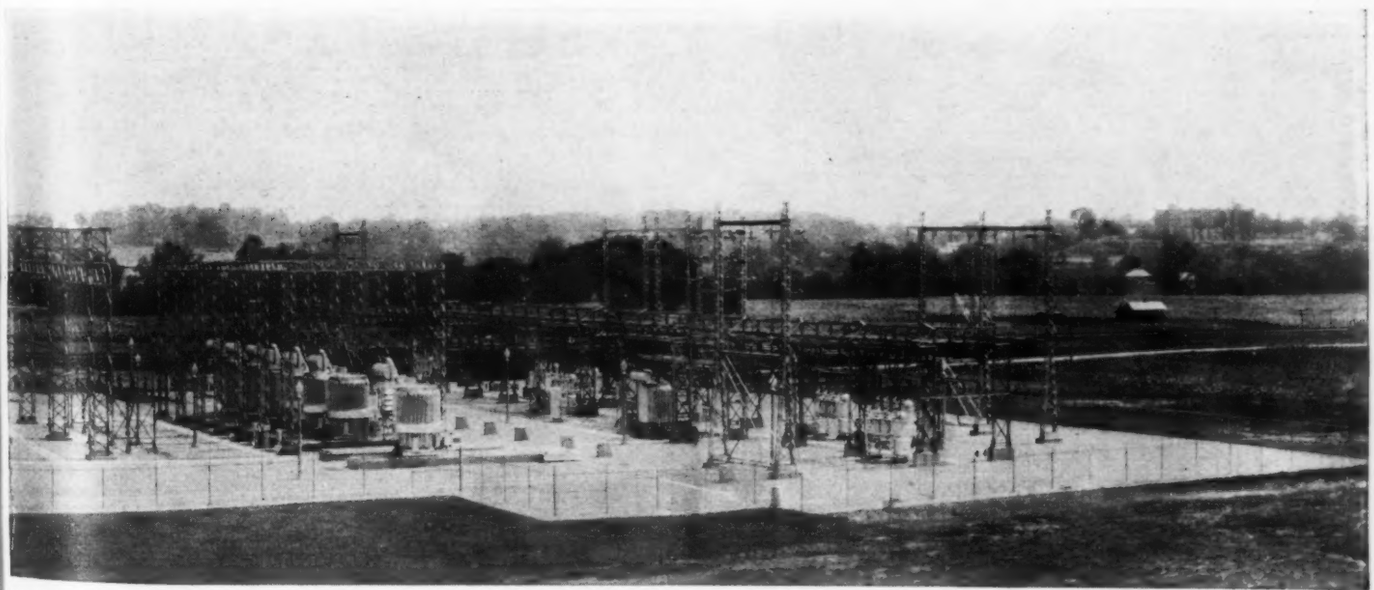
The grounding bank and the main station service bank 2,300-volt windings may be paralleled for a few seconds through breakers *M* and *N*, but there can be no sustained parallel operation.

This system of spare source of feed has been very acceptable, especially during the starting and testing period of plant operation.



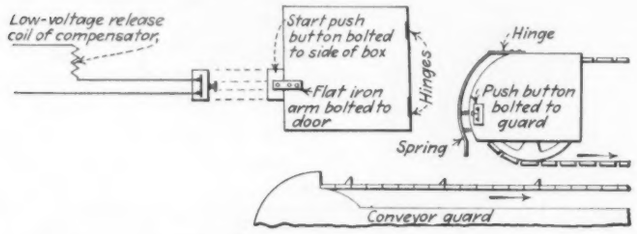
Grounding transformer serves as spare energy source for station supply

represents advanced practices



Push Buttons as Safety and Time-Saving Devices

Piecework operators of production machines do not like to spend time on work that does not swell their daily totals. If it is at all possible to do so they would rather change the set-up of a machine while it is running and take the risk of losing a finger in a gear box than to shut the machine down and start it again after the necessary change has been made, according to J. R. Estes, Louisville, Ky. But there are ways to make men careful even if they won't take the trouble to do so on their own account. One of the best ways is to use a push-button motor control in the proper place.



Compensator release coil and push buttons combined for safety

One sketch shows how opening a machine gear box opens the drive motor circuit. The other indicates how a machine feed conveyor is protected with normally closed buttons, one on each side, connected in series with the compensator release coil.

The button to use is the single-stop normally open type. Mount it on the machine so that when the gear box door opens the button is allowed to rise (circuit open). Connect the button in series with the low-voltage release coil of the motor-starting compensator. Then when the piecework operator forgets to shut down his motor before he opens the gear box door the push button remembers for him. The same connection and arrangement, but with the normally closed type of button, can be used with hinged railings and guards to prevent the accidental contact of persons or objects from damage to themselves or to the operating machines. But not only as safety devices are these single push buttons valuable. They can be used as limit switches for almost any duty. The wide-awake industrial plant electrician can find many places where their application will pay dividends in time, money and safety.

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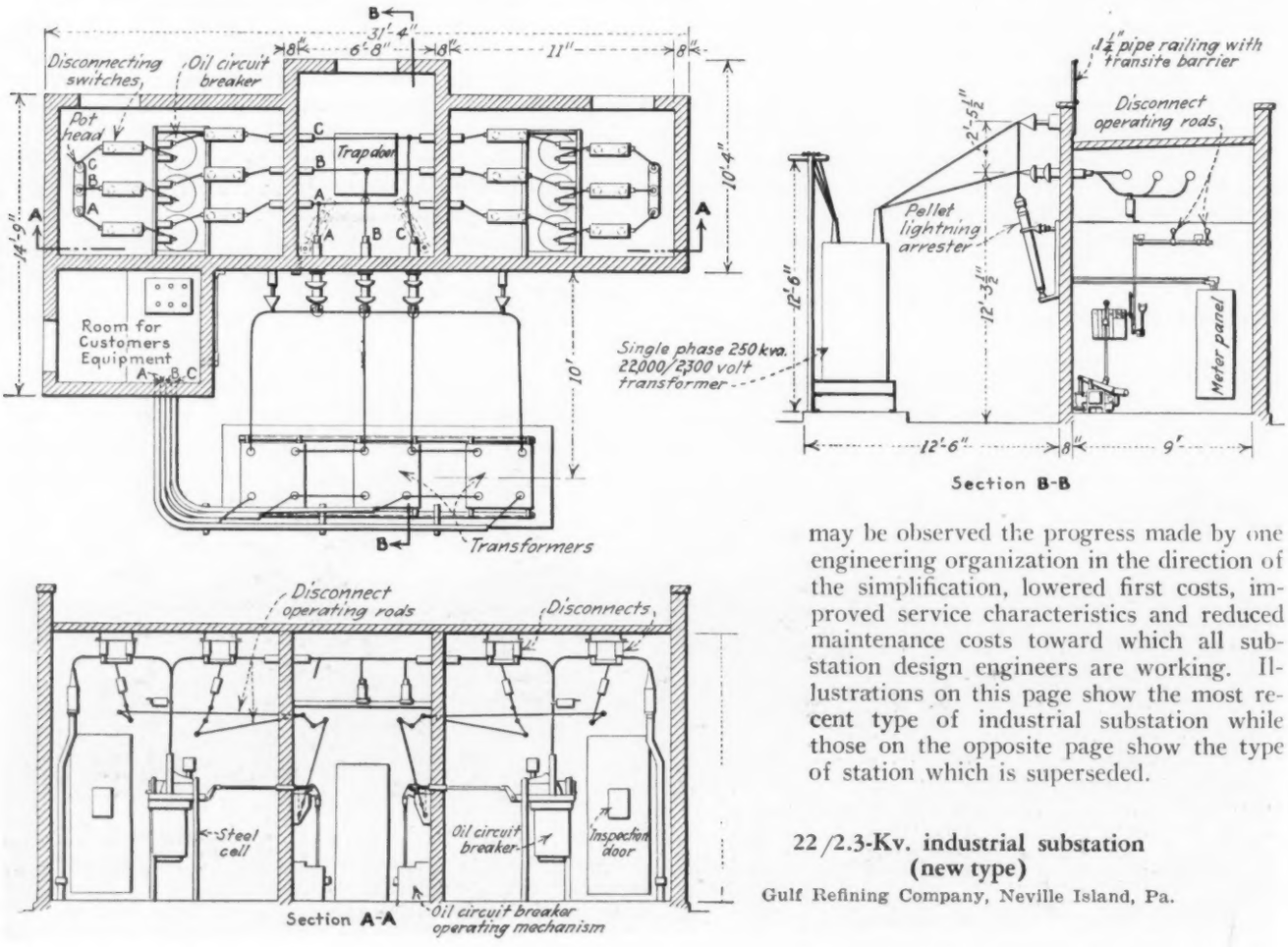
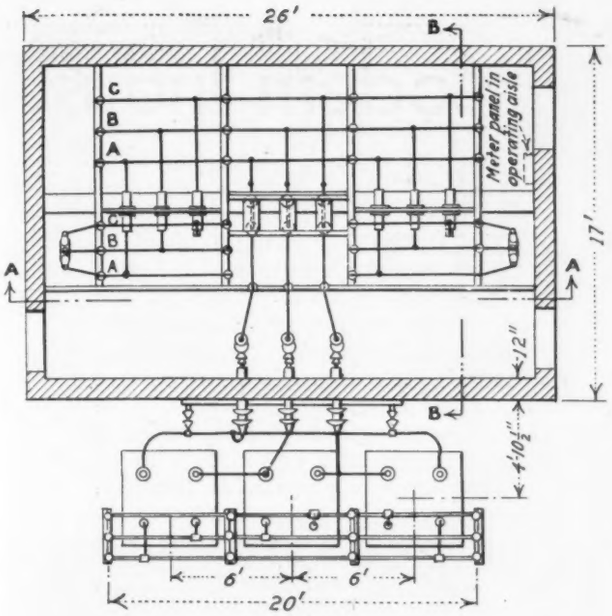
Industrial Substation Costs Clipped; Performance Bettered

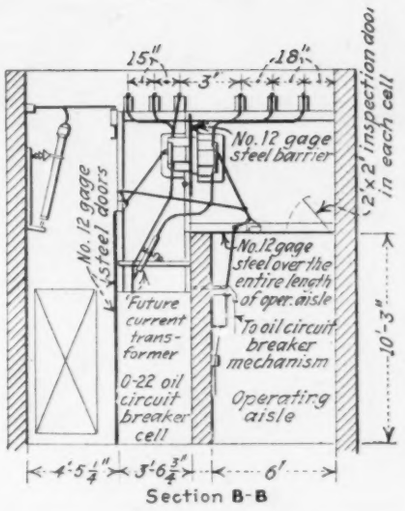
In the accompanying figures, showing the layouts for two 22,000/2,300-kw. industrial substations on the system of the Duquesne Light Company, Pittsburgh, may be observed the progress made by one engineering organization in the direction of the simplification, lowered first costs, improved service characteristics and reduced maintenance costs toward which all substation design engineers are working. Illustrations on this page show the most recent type of industrial substation while those on the opposite page show the type of station which is superseded.



22/2.3-Kv. industrial substation (new type)

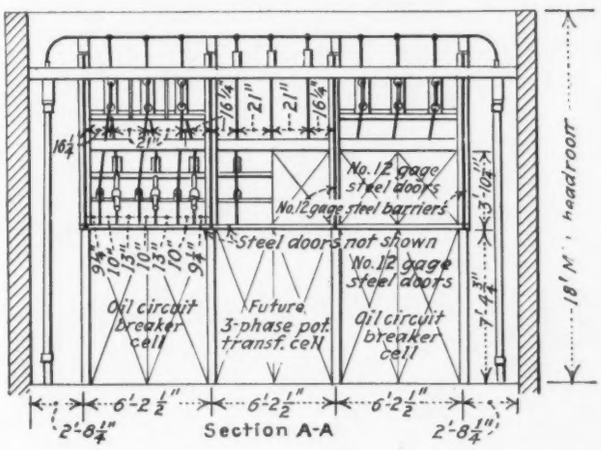
Gulf Refining Company, Neville Island, Pa.





22/2.3-Kv. industrial substation (superseded type)

Heppenstall Company, Pittsburgh, Pa.



The features and advantages of the design may be summarized as follows: By making the room in which the equipment is installed serve as the barrier between this equipment and adjacent equipment a simpler, cheaper and more reliable layout has been secured. It may be noted that a considerable amount of sheet-steel barrier work has been eliminated.

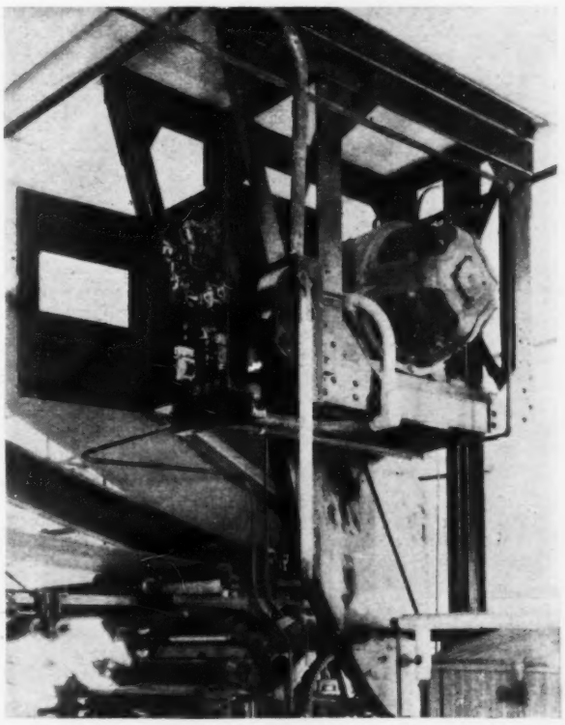
Briefly, the advantages of the new layout are:

1. Lower costs:
(a) Saving of 35 per cent in building costs due to reduction of 55 per cent in cubical contents.
(b) Savings of 12 per cent in equipment costs.
2. Simpler installation, owing to elimination of barrier work and structural supports.
3. Saving of 40 per cent in ground space required.
4. More reliable service, due to better isolation of equipment in case of failure.
5. Fewer points for failure, because of fewer insulators.
6. Decreased maintenance costs, due to simpler layout and to elimination of nearly all sheet-metal work.
7. Less heat required to prevent condensation, owing to decreased cubical contents.

The Pittsburgh branch of the Byllesby Engineering & Management Corporation designed and constructed the new type of substation herein described in collaboration with the engineers of the Duquesne Light Company.

Floor Space Saved by Motor Mounting

In placing the 20-35-hp. motors driving the print machines in the Paterson (N. J.) plant of the Textile Dyeing & Printing Company of America in frames suspended from the ceiling, this organization succeeded in clearing the working areas around the machines and in securing greater quiet within the plant. Safety factors were improved. Instead of using a gear reduction unit



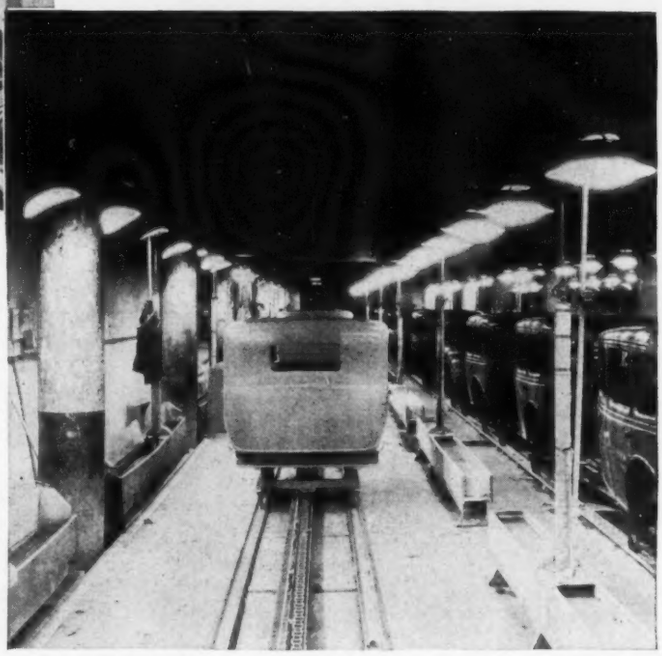
a silent chain drive accomplished the same purpose. Numerous push-button stations upon the print machines control the operation of the drive, while a rod-operated safety switch is within easy reach.

Modern Industrial

UP AND UP go the standards of acceptable intensities in industrial lighting. Practices and values differ for individual industries, plants and production functions, but today's plant output is a direct result of today's lighting installations. The accompanying examples were selected as representative of what is to be encountered in progressive factories.

General shop

Part of the Cleveland, Ohio, service shop of the General Electric Supply Corporation. Highbay lighting units spaced 20 ft. apart, 750 watts per unit; approximate intensity 18 foot-candles.

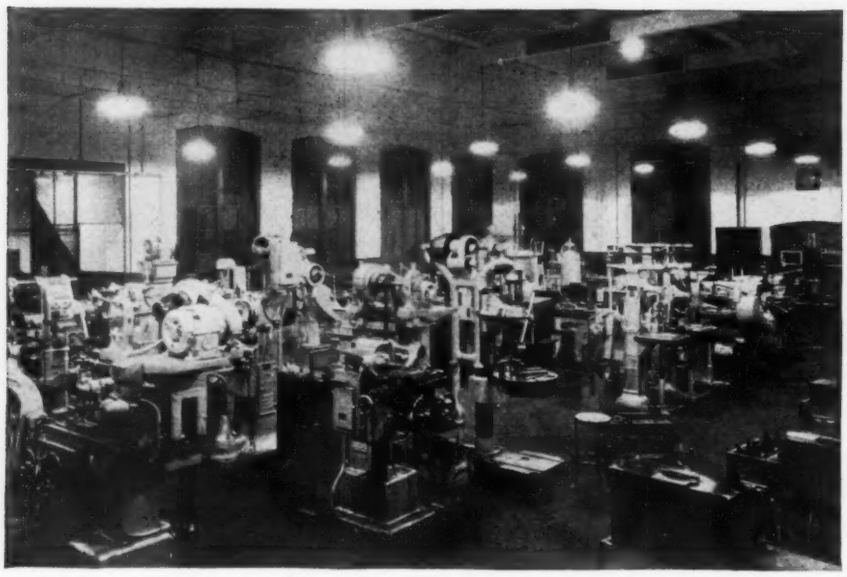


Automobile body finishing

Spray painting and body finishing at the Cleveland, Ohio, body division of the Hupp Motor Car Company. Fairly light walls and ceiling. "Glassteel" diffusers and elliptical angle reflectors 6 ft. 8 in. apart. Rows of units 10 ft. apart. Mounting height of luminaires —"Glassteel" 8 ft. 6 in.; angles 8 ft. All 300 watt (white bowl in angles). Foot-candles, 15-58 on work from angles, 8-30 from "Glassteels."

Machine shop

Toolroom of Garfield Manufacturing Company, Garfield, N. J. R.L.M. dome reflectors. Spacing of luminaires, 10x12 ft. centers Mounting height 12 ft.; 300-watt lamps, 18 foot-candles.

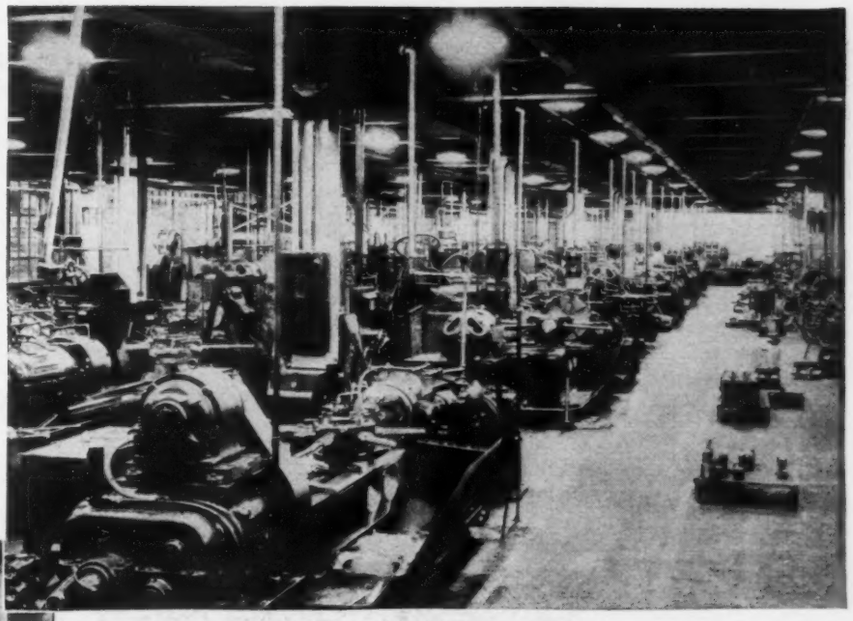


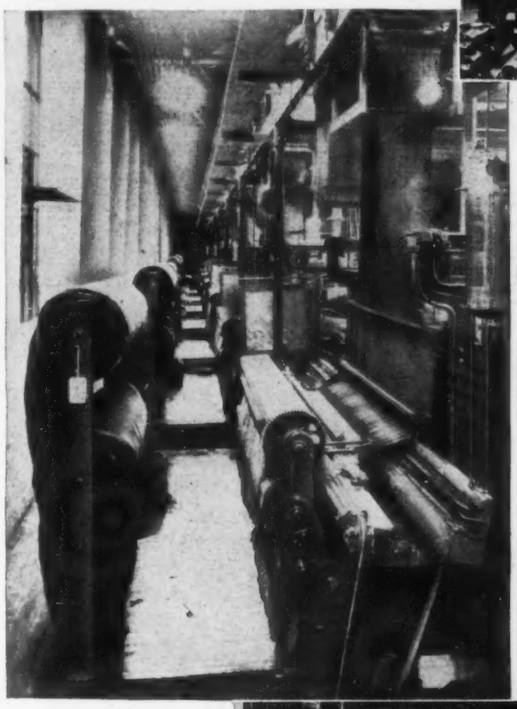
Courtesy
General Electric Company

Lighting

Textiles

Weaving of plush on most recent type plush loom at the Statesville, N. C., Statesville Cotton Mill; 300-watt "Glassteel" diffuser units, 300-watt clear lamps. Spacing: One unit between each two looms down work aisle; also one unit between each two looms down back aisle. This makes the spacing approximately 13x12 ft. 6 in. Mounting height, 13 ft. Wattage, 1.85 watts per square foot. Illumination, 10 to 12 foot-candles.



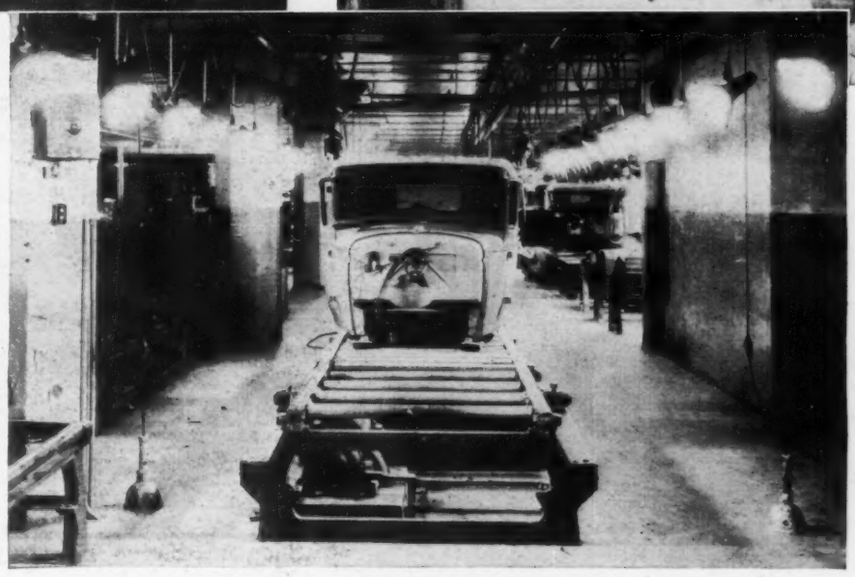


Machine shop

Hub department of the Hamilton Standard Steel Propeller Company at Homestead, Pa. RLM dome reflectors, four units per bay of 20x24 ft. with spacing of 10x12 ft.; 300-watt lamp.

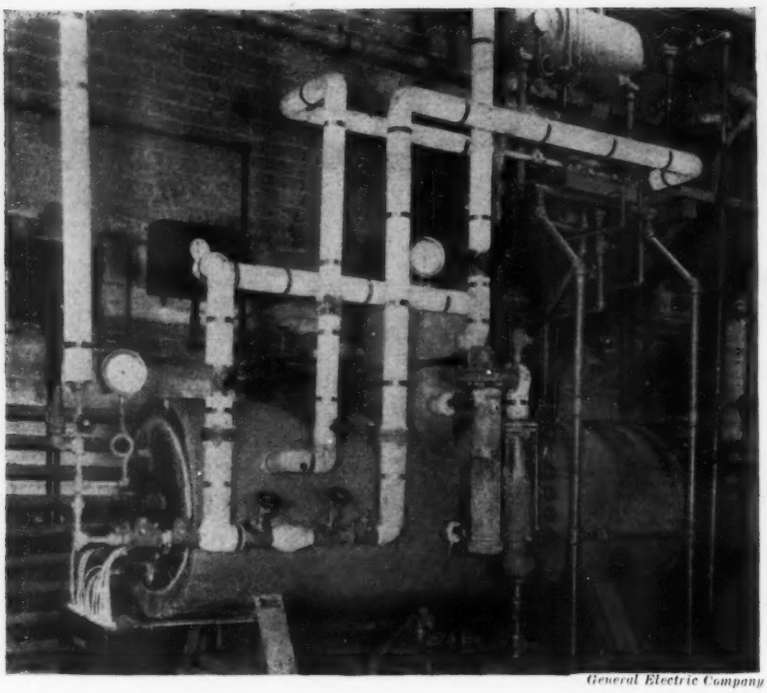
Automobile assembly

Body painting and finishing at the Cleveland, Ohio, plant of the Ford Motor Company. Light walls and ceiling; 20 Benjamin projectolites. Spacing of luminaires, 5 ft. two rows 12 ft. apart. Mounting height, 7½ ft.; 300-watt lamps 60-100 foot-candles on work.



Warehouse

Section of Cleveland, Ohio, warehouse of General Electric Supply Corporation. "Glassteel" diffusers using 300-watt lamps, mounting height 12 ft., spacing on 20-ft. centers. Approximate intensity 20 foot-candles.



General Electric Company

Process steam safely generated in plant with explosive atmosphere

Electric Steam Generator Solves Industrial Problem

Economy and increased safety both influenced the decision of the research department in recommending the purchase of an electric-steam generator when the Celluloid Corporation of Newark, N. J., was faced with the necessity of obtaining steam at 200 lb. pressure to be used in an atmosphere which might become explosive. The use of a 60/120-kw. electric-steam generator meant saving the cost of a new building which otherwise must be erected remote from the laboratory so that a fuel fire could be used with safety. It also made the employment of a licensed engineer unnecessary.

Accessory equipment includes an automatic pressure governor, an automatic heat shut-off and a low-water alarm whistle. Great care has been taken in the design of the equipment to minimize danger in its operation. For example, the magnetic switch operates in oil, the pressure governor is inclosed in a gas-tight case, and the automatic heat shut-off switch operates inside of the generator under 200 lb. pressure.

▼

Space Fans Save Dyers $1,000 Labor in Two Weeks

In the final drying and finishing rooms at the plant of a large New Jersey dyer of textiles humidity and its control play an important rôle. This large work area is of relatively low head-room construction, with a rectangular-section monitor roof extending across its length. Water vapor rising with the warm air from the driers tended to pocket upon certain temperature conditions instead of dissipating readily and drying processes were so seriously retarded as to affect production.

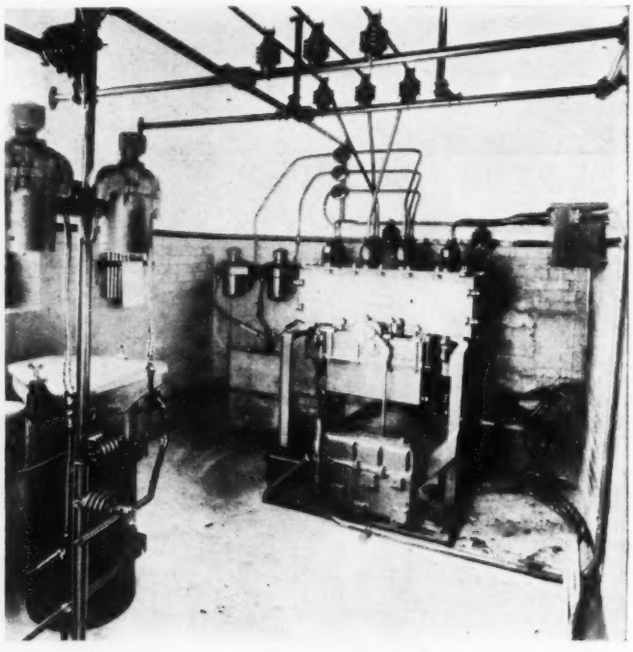
To overcome this difficulty small space fans with airplane type blades and driven by $\frac{1}{8}$-hp. motors were installed on 12-ft. centers. This arrangement, according to the plant's engineer, not only speeded production and improved working conditions but saved $1,000 in labor costs during the first two weeks that it was installed.

▼

Safeguarding Hospital Service

To prevent annoying interruptions of service to hospitals caused by the momentary failure of the preferred feeder in cases where the energy supply is duplicated, the Narragansett Electric Company is making use of automatic throw-over switches installed in vaults from which the local requirements are conveniently met. A typical installation, illustrated herewith, is at the Homeopathic Hospital in Providence. This institution, together with a near-by lying-in hospital, was formerly served by a 2,300-volt feeder from a single substation with a switching arrangement on a pole outside the hospital providing for manual transfer of load to a feeder from a different substation in case of interruption. While this furnished a measure of duplicate service, it involved objectionable delay in changeover.

The situation was remedied by bringing two three-phase feeders into a vault at the Homeopathic Hospital and terminating them in three-conductor potheads at either end of the switch. From the top of the switch connections are made to a bus from which the hospital trans-



Continuity of service aided by automatic throw-over switching installation serving two hospitals

former primaries are fed, with corresponding connections to the lying-in hospital. From the switch connections are also made through disconnecting type outlet bushings to two potential transformers, one on each feeder, which energize holding coils and supply power to the switch operating motor. If power fails or if the voltage on the preferred feeder drops below 60 per cent of normal, the load is transferred inside of two seconds to the auxiliary feeder. As soon as normal voltage is restored the load is thrown back upon the preferred feeder within 0.1 second. The switch can be operated manually if desired. Since this installation was made the G & W Specialty Company, which supplied the switch, has designed a new automatic mechanism which transfers the load from the preferred feeder in from 7 to 9 cycles and restores it in about 2 cycles. A number of these installations are now in use on the Narragansett system to serve local distribution centers as well as hospitals.

▼

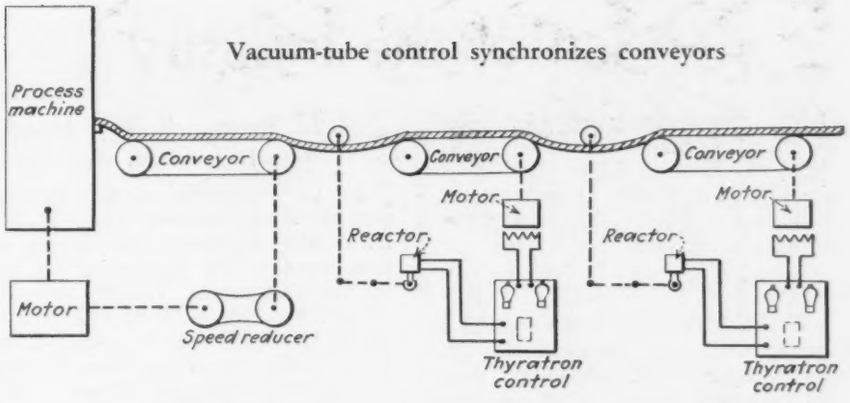
Conveyors Synchronized by Thyratron Control

Considerable reduction in wastage and an important simplification of production operation are said to have been realized by the B. F. Goodrich Company in applying thyratron control to the synchronization of conveyor motors. Conveyors are extensively used in much of the processing work in a rubber factory. It is important that the speeds of the various conveyors in a chain be synchronized. The speed of the synchronized group is usually determined by the speed of the material entering one conveyor. The speeds have heretofore been controlled manually, but the results were unsatisfactory as only a slight disagreement in speeds might be the cause of a high percentage of waste material.

In this installation the first conveyor, or the one receiving the original supply of material, is driven at a fixed rate of speed, depending on the material in question, and the other conveyors are synchronized with this key conveyor. The material, as it passes along, dips slightly between any two conveyors. In each of these dips rides a wheel attached to a balanced lever mechanism. The lever mechanism, at its other end, governs the movement of the core in a reactor. Variations in the reactance of the reactor (governed by the position of the core) control the output voltage of a pair of thyratrons in the circuit of the motor driving the conveyor.

By this arrangement when a conveyor is running too fast for the preceding one the slack material between them tightens, the rider wheel rises, the position of the core in the reactor is changed, the thyratron tubes pass more current to the motor field and the motor slows down. Conversely, when the conveyor is running too slow, the reactor core moves the other way, causing the thyratron tubes to pass more current and the motor speeds up. As a result, the tension between conveyors keeps the speeds in synchronism.

Vacuum-tube control synchronizes conveyors



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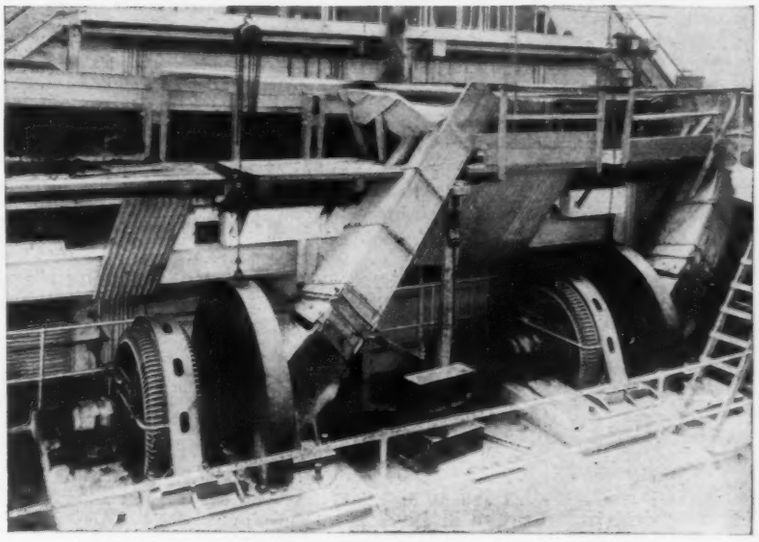
Space Saved and Production Increased by Direct Connection

Direct-connected chippers driven by synchronous motors at the mill of the Maine Seaboard Paper Company in Bucksport constitute an advance in practice over the traditional use of belted squirrel-cage or slip-ring motors for this purpose, according to the engineering department of the Electrical Machinery Manufacturing Company. In making the synchronous-motor application to this drive the motor was mounted in the space formerly occupied by the flywheel pulley, the motor frame being designed to accommodate the chipper frame, with ample starting, pull-in and pull-out torques. The motors are rated at 225 hp. and run at 257 r.p.m. The chipper manufacturer states that the direct-connected synchronous motor increased the pulp tonnage 25 per cent over that obtained with the superseded belt drive, owing to the constancy of speed, elimination of belt loss and slippage and inherent high efficiency of the synchronous motor.



Men of the Industry

STERLING UPDYKE of Little Rock, director of public relations for the Arkansas Power & Light Company and the Phoenix Utility Company since 1929, has resigned. Mr. Updyke will engage in the insurance business.

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W. M. HERBRUCK, formerly with the engineering department of the Ohio Power Company, Canton, Ohio, is now chief electrical inspector for the American Electric Switch Corporation, Minerva, Ohio.

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ALBERT L. MAILLARD, consulting engineer of Kansas City, Mo., served as general chairman of the Southwest Power Conference held recently in that city. He also served as chairman of the Southwest Power and Mechanical Exposition held in connection with the conference. Mr. Maillard is a member of the American Institute of Electrical Engineers.

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E. A. ROEHRY has been appointed chief engineer of the Central Illinois group of the Illinois Power & Light Corporation. The position to which he has been assigned is a new one created by the company. Mr. Roehry will have general engineering supervision of the six divisions in the Central Illinois group. He was formerly general manager of the St. Louis Electric Terminal Railway Company.

•

LA MONTE J. BELNAP has been elected chairman of the executive committee of the Worthington Pump & Machinery Corporation and is succeeded as president by HARRY C. BEAVER, formerly vice-president. As chairman of the executive committee, Mr. Belnap maintains his active part in directing the manufacturing, sales and financial activities of Worthington. He also is president of the Consolidated Paper Corporation, Ltd. Mr. Belnap has an international reputation as an industrialist and financial organizer. Mr. Beaver has been associated with Mr. Belnap in various enterprises for the past 25 years.

•

ROSCOE SEYBOLD has been appointed comptroller of the Westinghouse Electric & Manufacturing Company, advancing to the position from that of assistant to the president. Mr Seybold has been continuously in the service of the Westinghouse company for 24 years. A native of Rockville, Ind., and a graduate of Purdue University, he joined the Westinghouse organization in 1907.

J. H. Trumbull New Head of N. E. M. A.

JOHN H. TRUMBULL, whose election to the presidency of the National Electrical Manufacturers' Association was announced in the September 26 issue of the ELECTRICAL WORLD, began his electrical career with the Eddy Electrical Company of Windsor, Conn., going from there to the Crocker-Wheeler Company at Ampere, N. J. He later went into the electrical contracting business in Hartford, Conn., and in October, 1899, started the manufacture of electrical rosettes and other

wiring supplies in a small wooden building at Plainville with two associates, under the name of the Trumbull Electric Company, changed later to its present name. The business and financial training obtained in the operation of his own factory was of great service during Mr. Trumbull's term as state Senator when he served on the finance committee from 1921 to 1925, and also during his three successful terms as Governor of Connecticut, from 1925 to 1931. At the end of his third term he declined renomination. He then devoted his entire attention to the electrical industry.

Mr. Trumbull's activity in the National Electrical Manufacturers' Association work started with membership in the Electrical Manufacturers' Club, formed in 1905, of which he is past-president and still an active member. At the time of the formation of the Associated Manufacturers of Electrical Supplies he was elected governor and served, with the exception of one term, on the governing board until the consolidation of the Associated Manufacturers of Electrical Supplies, the Electrical Power Club and the Electrical Council under the present title of the National Electrical Manufacturers' Association. He was elected a member of the new board of governors of the consolidated electrical association and, with the exception of one year, has since served on that board. He has also been a member of the executive committee and a member of the committee of legislation affecting electrical manufacturers and has taken an active interest in all of this work.

In addition to his activities in electrical manufacturing and in association activities, which he followed closely during his term as Governor, he became interested in aviation and earned the well-known title of the "Flying Governor."

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OBITUARY

GEORGE B. WILLCUTT, vice-president, secretary and a director of the Market Street Railway Company, San Francisco, and for a number of years an assistant secretary of the California Oregon Power Company, died September 17 in San Francisco at the age of 72. He was the dean of street railway transportation men on the Pacific Coast, having completed 45 years' association with the Market Street Railway Company and its predecessors.

•

ARTHUR KENDRICK, president of the International Equipment Company, Boston, and formerly a professor of physics at the Rose and Worcester Polytechnic Institutes, died at Newton, Mass., September 23. Professor Kendrick was born at Nashua, N. H., 66 years ago and was educated at Amherst and Harvard colleges. He founded the International Instrument Company, at Cambridge, Mass., in 1901, which later became the equipment company named.

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GIFFORD LECLEAR, for many years a prominent member of the engineering and architectural firm of Densmore & LeClear, Boston, Mass., died at his home in Waban, Mass., September 24. Mr. LeClear was about 57 years of age and was educated at Harvard University. In partnership with the late Edward Densmore he became noted for the engineering design and construction associated with the erection of the Harvard Medical School group of buildings at Boston, and for many years performed similar work for institutional and other enterprises, including the Park Square Building at Boston, the New England Telephone & Telegraph Company's Bowdoin exchange building and numerous others. To an unusual degree he combined the attributes of the engineer and the architect in one personality.

Financial and Statistical News

TEN and twelve point price declines in utility preferreds in single sessions this week, as new lows were established in nearly all classes of securities, call attention to the indiscriminate dumping of high-grade preferred stocks as well as more speculative common stocks. The public at this stage shows little discrimination between the strongest and the weakest issues.

——ALMOST THE SAME MAY BE SAID OF BONDS. Although in most cases no developments have arisen to alter the intrinsic worth of utility bonds within the past few months, many holding company debentures are selling 25 points below quotations of three months ago, so that yields are close to 6 per cent in the case of many standard issues. Mortgage bonds of operating companies have shown greater resistance and prices have been better maintained.

——COMMON-STOCK AVERAGE OF 37 UTILITIES closed September at a new low for the year of 45.7, against a high of 74 for the year.

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Customer-Ownership Gains Despite Depression

CUSTOMER OWNERSHIP IN THE utility industry made distinct advances last year despite the depression. In 1930 the utilities sold 1,671,616 shares of stock, 15 per cent more than in 1929, to 115,013 customers, 30 per cent more than bought in 1929. These are some of the facts brought out by the annual report of the customer-ownership committee of the National Electric Light Association covering three-quarters of the industry.

An interesting résumé of stock sold to customers since 1929, when the movement really got under way, is included. From 1914 to the end of last year 21,919,775 shares of stock were sold to 2,086,118 customer buyers.

Surveying the present customer ownership situation the report says:

At the end of 1930 four-fifths of the total stock of these companies was in the hands of 628,512 individuals, of which 28,237 were employees, 443,510 were customers and 156,765 were individuals outside of the territory served. The average holding of the employees was 51 shares, of customers 31 shares and of individuals outside of the territory served 87 shares. One of every three employees of these companies held stock, according to the reports.

The figures of sales for 1930 appear to indicate a substantial rate of increase in the trend of customer-ownership activities in the industry, but that this rate of increase is considerably greater among companies which have apparently been more consistently engaged in customer-ownership activities than for the industry as a whole. It would seem that many companies have overlooked, and are now overlooking, an opportunity for marketing their preferred stocks through customer-ownership campaigns under present satisfactory market conditions.

Taking into consideration the tremendous opportunities in undeveloped and partially developed fields for increased sales of electricity, an estimate of the amount of money required to be raised during the next ten years may be conservatively set at $7,500,000,000, of which the sale of preferred stocks should provide not less than $2,000,000,000.

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Denies North American Will Cut Dividends

REFERRING TO RUMORS regarding a change in the dividend policy of the North American Company, President Frank L. Dame said that these rumors, which were entirely without foundation, and were circulated for the sole purpose of depressing the market price of the stock, coincided with the removal of the Stock Exchange ban on short selling. Mr. Dame added that no change in the dividend was in contemplation and that the record of the company over the past eight years, during which dividends have been paid in stock at the rate now in force, clearly demonstrated the wisdom of the practice and the justification for its continuance.

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Sinking Fund Not Needed in Expanding Industry

The following opinion has been expressed by leading investment bankers specializing in utility securities on the question of the necessity, or otherwise, of sinking funds on long-term utility issues

IT IS probably quite natural that, in a time of business depression, there should be raised again the question whether issues of public utility bonds ought to carry sinking funds for their gradual retirement. It is proper to recall the history of the discussion and to bear in mind the fact that such issues once did commonly include provisions for retirement through sinking funds and that the requirement was dropped from the later indentures not because the financiers of the industry became less conservative but simply in response to the demand for provident financing. The sinking fund served in the past and still serves one of two purposes. It may provide for the orderly return of capital to the investors in a business with wasting assets, such as a mine or an oil well, or it may accomplish the reduction of the debt of a business, the assets of which are maintained permanently. In the latter case the effect is the transfer of ownership, in part, from bondholders to stockholders.

The electric power business, far from being one with wasting assets and a consequent need for smaller investment, was found years ago to be one requiring steadily increasing amounts of new capital. It was consequently decided by utility operators and bankers that provision for the progress of the industry was only made more difficult and complicated if a company, while borrowing with one hand for additional development, was obligated, by the provisions of an indenture, to pay off debt with the other hand. No such provisions for retirement could justify their existence in a period of expansion, such as the country has demanded in the last generation of the electric power industry. Furthermore, if it be admitted, as we find that it is generally admitted, that the possibilities for further expansion still are without definite limit,

no case can be made on these particular grounds for the imposition of requirements for periodic repayment of debt, it is claimed. It might seem a startling signal of financial improvidence that certain unsecured obligations of public utility holding companies have a maturity nearly one hundred years distant and bear no provision for gradual retirement. Yet bankers see no reason for the application of different principles to any part of the financing mechanism of the business no matter how long the term involved, and such an attempted reflection upon the "hundred-year debentures" loses some of its sensational effect if we consider the sums invested, at fixed rates of return, in non-maturing securities of the same companies, viz., in the preferred shares.

If it is maintained, on the other hand, simply that the retirement of interest-bearing obligations, through additional investment by stockholders, will improve the credit of the public utility industry, we have before us questions of fact and of internal policy. We believe any implication that the industry should be without funded indebtedness extreme and contrary to the experience of other public service enterprises. There would seem to be no reason why human nature should so far change that a great many investors will not prefer to accept lower returns on bonds and preferred stocks if, at the same time, they receive compensation against risk. It is undoubtedly true that reduction of interest-bearing obligations improves the credit of a company or an individual, but, with the standing of the public utility bonds and preferred stocks relatively as high as it is, the burden of proof is on those who find the proportion of such fixed income-bearing securities excessive.

The discussion of sinking funds usually is linked with a reference to policies of accruing depreciation and sometimes, apparently, without clear recognition that the two things are, in a sense, mutually exclusive; that is, that proper provision for depreciation means simply the maintenance of the value of the investment and obviates the need for a return of any part of that investment in the form of retirement funds. What the stockholders of the power industry have constantly been doing is to set aside a part of the proceeds of the year's business for the replacement of those parts of the fixed plant which are expected to wear out or become obsolete. If the business were declining in importance, it might be found unnecessary to replace these parts, with the natural result that the funds set aside should be and would be used for the purchase or retirement of bonds. With the business growing as rapidly as it has during these last years, there has, of course, been no option open to the proprietors of the power business. Not only have they found it necessary to use their funds so set aside for the replacement of worn-out and obsolete equipment, but they have in many cases relinquished a part of their legitimate return on the old investment to make a new one.

It is not here contended that the public utility industry has proceeded in a scientific fashion to provide for depreciation and obsolescence. That there has been a great divergence of opinion as to a proper policy by which to accrue reserves and a consequent lack of uniformity in practice has probably been a natural aspect of a period of extremely rapid growth. Every conservative operator and banker will welcome further discussion of this whole subject, with a view to reaching, as nearly as may be, sound and uniform policies for accruing such reserves and for reporting them clearly. Such discussion should be particularly fruitful at a time like the present, when new investment is temporarily being made in smaller amount.

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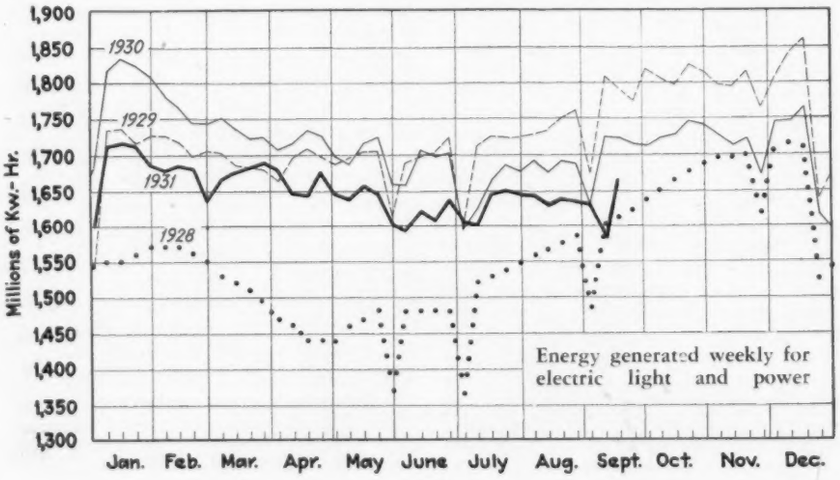
September Rise in Output

ENERGY OUTPUT OF electric light and power companies rose to a somewhat higher level in the week of September 19, compared with the period preceding Labor Day, and remained there during the following week. The change parallels the increase noted in other years at this season, as is evident from the table, which gives estimated weekly outputs as published by the National Electric Light Association.

Recent weeks do not reveal any marked changes in regional conditions: Generation on the Atlantic seaboard continues equal to that of last year or very slightly less; the central industrial region is still off 5 per cent, which is a little better than the showing a few weeks ago; the Pacific Coast has been between 4 and 5 per cent below 1930 operations.

	1931	1930	1929	1928
August 22.....	1,643	1,691	1,750	1,576
August 29.....	1,638	1,688	1,762	1,586
September 5...	1,636	1,630	1,675	1,484
September 12...	1,582	1,727	1,806	1,604
September 19...	1,663	1,722	1,792	1,614
September 26...	1,660	1,714	1,778	1,623



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Pound Depreciation Affects Our Utilities Little

WILL THE ABANDONMENT of the gold standard by Britain have any adverse effects on the utility industry in this country? While it is too early to see all probable consequences, and while possible later action by Great Britain on stabilization has an important bearing on the situation, opinions of industry leaders, economists and others are significant.

One would look for the most direct bearing in the case of companies, such as Utilities Power & Light Corporation, which control properties in Great Britain. Officers of that organization, however, state that fluctuations in the pound sterling will have no effect on the actual worth of the system's properties either here or abroad, nor upon the corporation's ability to pay dividends. Advances to the English properties, company officials state, have been made on a dollar basis.

Utilities Power & Light, furthermore, has permitted British earnings to be carried to surplus and reinvested in extensions and additional properties in England. Officials state that the company is in a position to continue this policy and will likely carry it on for years to come. It is apparent that any additional American capital invested in the English properties will have a substantial premium added to it.

It is obvious also that the reverse effect must apply in the case of American investments in English utilities where dividends or interest are payable in sterling. The effect, so far as the American investor is concerned, is similar to a dividend cut.

Along the same lines, it is pointed

CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND POWER COMPANIES

Operating Companies

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
Detroit Edison (Year ended August 31)					
Gross earnings	$50,743,676	$55,247,390	— 8.1	66	67
Net earnings	17,257,304	17,972,065	— 3.9	..	..
Eastern Texas Electric (Year ended July 31)					
Gross earnings	9,777,149	10,181,757	— 4.0	62	59
Net earnings	3,739,831	4,249,510	—12.0	..	..
Georgia Power* (Year ended July 31)					
Gross earnings	25,652,035	26,583,200	— 3.5	50	48
Net earnings	12,848,081	13,856,062	— 7.2	..	..
Gulf States Utilities (Year ended July 31)					
Gross earnings	6,746,778	7,081,430	— 4.8	59	55
Net earnings	2,767,789	3,209,628	—13.8	..	..
Louisville Gas & Electric (Year ended July 31)					
Gross earnings	10,854,471	10,444,559	3.9	..	..
Net earnings	5,825,366	5,389,573	8.1	..	..
Northern States Power (Year ended July 31)					
Gross earnings	33,801,613	33,128,246	2.0	..	..
Net earnings	17,056,892	16,816,060	1.4	..	..
Oklahoma Gas & Electric (Year ended July 31)					
Gross earnings	12,901,447	14,751,795	—12.6	..	..
Net earnings	6,028,284	6,902,823	—12.6	..	..
Puget Sound Power & Light† (Year ended July 31)					
Gross earnings	16,425,388	17,042,685	— 3.6	57	57
Net earnings	7,103,551	7,283,678	— 2.5	..	..
San Diego Consolidated Gas & Electric (Year ended July 31)					
Gross earnings	7,402,241	7,248,876	2.1	..	..
Net earnings	3,776,765	3,494,094	8.1	..	..
Southern California Edison (Year ended July 31)					
Gross earnings	41,247,713	40,997,872	1.0	32	33
Net earnings	28,112,208	27,295,991	3.0	..	..
Tennessee Electric Power (Year ended July 31)					
Gross earnings	13,957,736	15,328,654	— 8.9	52	51
Net Earnings	6,740,984	7,483,817	— 9.9	..	..
Virginia Electric & Power (Year ended July 31)					
Gross earnings	17,091,791	17,188,030	— 0.6	55	55
Net earnings	7,795,938	7,753,534	0.5	..	..
Wisconsin Public Service (Year ended July 31)					
Gross earnings	5,600,997	5,603,812	— 0.0	..	..
Net earnings	2,324,202	2,415,146	— 3.8	..	..

Holding Companies

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
American Commonwealths Power & Affil. Cos (Year ended July 31)					
Gross earnings	$26,947,283	$27,444,259	— 1.8	49	54
Net earnings	13,776,421	12,693,295	8.6	..	..
American Water Works & Electric & subs. (Year ended July 31)					
Gross earnings	52,003,762	55,122,823	— 5.6	52	50
Net earnings	25,131,825	27,443,079	— 8.4	..	..
Cities Service (Year ended August 31)					
Gross earnings	43,700,152	59,109,386	—26.0	..	..
Net earnings	41,149,812	57,110,650	—27.8	..	..
Electric Power & Light & subs. (Year ended June 30)					
Gross earnings	83,597,850	63,649,342	31.2	49	50
Net earnings	42,974,524	31,484,837	36.4	..	..
Engineers Public Serivce & subs. (Year ended July 31)					
Gross earnings	52,567,867	52,445,744	0.0	..	..
Net earnings	22,474,545	22,429,663	0.2	..	..
Federal Light & Traction & subs. (Year ended July 31)					
Gross earnings	8,297,405	8,500,341	— 2.4	57	57
Net earnings	3,589,993	3,649,650	— 1.6	..	..
Philadelphia Company (Year ended July 31)					
Gross earnings	59,060,384	63,019,878	— 6.3	..	..
Net earnings	29,789,323	30,846,925	— 3.4	..	..
Public Service Corp. of New Jersey & subs.† (Year ended August 31)					
Gross earnings	139,050,754	138,832,969	0.6	67	70
Net earnings	45,462,276	42,792,885	6.2	..	..
Standard Gas & Electric & subs. (Year ended July 31)					
Gross earnings	150,202,016	155,510,714	.....	3.4	..
Net earnings	73,208,629	74,804,006	.....	2.1	..

* Columbus Electric & Power included.

† Operating expenses include depreciation.

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out that British minority investment in American utilities, as in other American enterprise, will undoubtedly be seriously curtailed while the pound is so sharply discounted.

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Connecticut Utility Increases Capital

STOCKHOLDERS OF THE Connecticut Light & Power Company met at Hartford, Conn., September 22 and voted to increase the capital stock from $40,000,000 to $65,000,000. Under the plan it becomes the second largest capitalized company in the state, being led by the New York, New Haven & Hartford Railroad Company. It was voted to change the rate of the 7 and 8 per cent preferred to 5 per cent, the call price being reduced from $120 to $110.

The increase is to take care of the merging of the Waterbury Gas Light Company and the Winsted Gas Company with the Connecticut Light & Power Company and to retire obligations. The stocks of these gas companies and the common stock of the Connecticut Light & Power Company are owned by the Connecticut Electric Service Company. Notes of $5,000,000 held by the last-named company will be retired by the proposed issue.

Utility Issues $34,500,000 in September

DURING THE MONTH of September new offerings of securities by the electric light and power companies of the country totaled $34,500,000, as compared with $27,975,000 in August and $156,829,000 in September a year ago. This figure brings the nine-month period to a close with a total of $1,139,420,000, against $1,124,191,934 for the similar period of 1930. The largest individual offering was made by the Edison Electric Illuminating Company of Boston in the form of one-year 4½ per cent notes totaling $20,000,000.

New Security Issues of Electric Service Companies in September

Name of Company	Amount of Issue (Par Value)	Period (Years)	Class	Purpose	Interest Rate	Price	Per Cent Yield
Tide Water Power Co.	$1,000,000	48	First mortgage gold bonds, series A	Acquisition of new properties, for improvements and betterments and for other corporate purposes	5	91½	5.50
Jersey Central Power & Light Co.	6,000,000	..	Cumulative preferred stock	Acquisition of new properties	5½	100	5.50
Indiana Electric Corp.	2,500,000	1	Gold notes	To retire unfunded debt and to provide for additions and extensions	4½	99½	5.00
Metropolitan Edison Corp.	5,000,000	30	Secured consolidated refunding gold bonds	To pay in part for subsidiary companies' securities or to pay indebtedness incurred for that purpose	6	100	6.00
Edison Electric Illg. Co. of Boston	20,000,000	1	Coupon gold notes	To retire notes and to settle all floating indebtedness of company	4½	100	4.50
Total	$34,500,000			Rights			
Total amount actually realized	34,402,500			Total financing		$34,402,500	

Business News and Markets

Middle West Sells More Appliances

IN THE FACE of a customary seasonal decline, the sales of load-building appliances by subsidiaries of the Middle West Utilities Company in July have not only held to the level of the preceding month, but slightly exceeded it. This is the fourth successive month to show an increase over the preceding month, according to C. J. Eaton, vice-president.

"Heavier load-building appliances are in greater use this year than ever before," Mr. Eaton said. "Estimates indicate that during the first six months of 1931 the electric refrigerators on the lines of the system increased 11 per cent, electric ranges 12 per cent and electric hot water heaters 16 per cent.

"Annual service revenue from electrical merchandise sales made during the first six months of this year will be close to one million dollars. A substantial portion of the investment to serve the additional load is already being carried."

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Says Anti-Trust Laws Should Be Modified

IN A STATEMENT ISSUED in Chicago recently, Otto H. Kahn of Kuhn, Loeb & Company advocated, among other things, a modification of our anti-trust laws. Mr. Kahn said:

"Modify our anti-trust laws, especially the Clayton act, so as to bring them into keeping with modern conditions. Of course, we will not have monopoly in this country. Nor shall we relax the watchfulness of the government in that respect, or weaken the instrumentalities available for the protection of the public against excessive concentration of business power, or socially undesirable business methods and tendencies. On the contrary, our trend will be, in my opinion, to make the conduct of business increasingly a matter of public concern.

"We believe in competition. But we do not want laws which result in destructive, wasteful competition, detrimental to legitimate trade and enterprise and the economic welfare of the country. We do not want laws which, without elasticity, discrimination or adaptability to changing circumstances, constrain unregulated production and stand in the way of the avoidance of over-supply, of waste motion and of costly duplication of effort; which forbid useful co-ordination among those engaged in the same line of business; which, while aiming at a desirable end and seeking to preserve a righteous principle, overshoot the mark in that they prohibit and penalize certain actions which, subject to proper supervision and regulation, should not merely be permitted but, in fact, encouraged."

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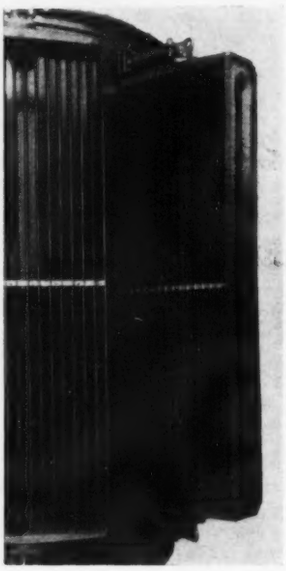
"Blown-Up" Radiators



TWO LONG STRIPS of 1/20-in. thick steel are weldel together around the edges and then "blown up" by air pressure. This is the way Westinghouse Electric & Manufacturing Company makes transformer radiators.

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Kearney Expands Plant

FORMAL OPENING OF its new plant addition was held on Friday, September 25, by the James R. Kearney Corporation, St. Louis, Mo. The new quarters not only increase the capacity several times but also afford the most modern facilities for the company's ever-increasing engineering department and a very unique display of its complete line of overhead and underground utility equipment. Modern soundproof offices are provided for all executives and department heads.

The James R. Kearney Corporation has had a phenomenal success in view of its having been founded less than five years ago.

General Electric Has New Mazda Lamp Sales Plan

A NEW MINIATURE "Mazda" lamp sales plan which offers distributors and dealers compensations and discounts ranging from 5 per cent to 7.5 per cent above those formerly provided and is calculated to remedy the uneconomic factors which have grown from changes in market conditions and distribution channels has been announced by the incandescent lamp department of the General Electric Company. The new 1931 sales plan, which applies both to Edison "Mazda" lamps and General Electric "Mazda" lamps, follows a twelve-month analysis and survey of all phases of the miniature lamp business.

The new plan, besides offering the wholesaler full protection on stock on hand in case of list price reductions, protects him against losses from obsolescence, fire and flood. In addition, it frees the wholesaler from investment charges on stock and aims to promote the stability of his business on miniature "Mazda" lamps. Dealer discounts have been sizably increased and a program of merchandising assistance inaugurated that is designed to make for greater sales and quicker turnover.

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Welding Design School Is Opened

A SCHOOL OF WELDING DESIGN to teach engineers, architects, draftsmen, etc., both in and out of its employ methods of designing welded buildings has been opened by the General Electric Company at Schenectady.

There is no charge for instruction in the course, which requires approximately four weeks for completion. It is a flexible one and can be adjusted to suit each individual. The course requires that the applicant be an engineer, or have some training in structural design or some experience in the design of riveted structures, according to the announcement made.

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New York Metal Prices

	Sept. 23, 1931 Cents per Pound	Sept. 30, 1931 Cents per Pound
Copper, electrolytic	7	7
Lead, Am. S. & R. price	4.40	4.40
Antimony	6.50	6.60
Nickel, ingot	35	35
Zinc, spots	4.05	4
Tin, Straits	23	22⅝
Aluminum, 99 per cent	23.30	23.30

Market Conditions

STAPLES in the equipment trades are moving better on the Pacific Coast than formerly, although volume of new business has not changed much. Street-lighting business is a feature. Building jobs of size are scarce this week, and there is little disposition on the part of utilities or large industrials to make commitments at this time.

——GOVERNMENT BUSINESS IS AN IMPORTANT PART of immediate orders in the Eastern district. Domestic apparatus also is moving at a better rate. Demand for street-lighting equipment is improving.

——NEW ENGLAND REPORTS AN INCREASE IN INQUIRIES for small power equipment.

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PACIFIC COAST

—THE GENERAL RUN *of business is much better than six months ago, although outstanding orders are fewer and therefore the volume is little improved. However, staples are moving better and in more encouraging quantities. Collections are improved slightly, but attachments have increased despite improvement in consumer payments.*

—A SELLING CAMPAIGN *for electric ranges, air heaters and refrigerators is being launched by the Pacific Gas & Electric Company, the past year having shown fair household current increases.*

A new steam plant, to cost approximately $3,000,000, is being planned for southern California, in the Orange County district, for 1932. Power company purchases include a carload of 125,000-volt insulators for southern California, three 1,500-kva. transformers valued at $40,000 for Stockton district, four General Electric transmitters and dynamotors for ferry service on San Francisco Bay, a 60-kva. regulator for Ukiah, miscellaneous feeder units for San Francisco, a bank of Westinghouse power transformers valued at $25,000 for central California and $5,000 worth of small transformers and circuit breakers for Honolulu. The Reno district is quieter, there being about half of the 90 electrical journeymen at work there earlier in the year. Excellent sales of lamps and lighting fixtures especially were recorded there during midyear, due to special character of installations.

Underground cabling jobs approximating $60,000 each are being planned for Hayward and San Anselmo. Street-lighting installations are good, 136 duplex standards being planned for Oakland at an estimated cost of $50,000, together with a Los Angeles concrete pole job of about the same size and a San Francisco installation. About $20,000 worth of work will be done in redesigning the San Diego distributing system for the United States government plant. Several large jobs, such as the Legion and War Memorial Building in San Francisco, are almost ready for electrical work. Residential building is excellent, but the $500,000 unit for the University of California medical building in San Francisco is the only large building job reported this week in the Bay area.

Resumption of several large lumber mills in western Washington during the past ten days with full crews is considered an indication that this source will re-enter the buying field, on a small scale at any rate, shortly. Sales announced during the week included 30 machines from 100 hp. down to pulp and paper mills and miscellaneous sources, about $3,500 worth of miscellaneous switchgear, fifteen transformers from 1½ kva. to 25 kva. and about 70 oil burner controls, fifteen motors from 25 hp. down to scattered industrials and dealers, ten transformers, 15 kva., to a power company and ten motors to mines, ranging from 35 hp. down, and 40 motors from 50 hp. down to scattered sources, including lumber mills.

Equipment for a street-lighting system in Kennewick, Wash., costing $9,000, involving 57 standards and 9,000 ft. of cable, is reported sold. Puget Sound Power & Light Company will spend several thousand dollars rebuilding two river crossing transmission lines near Everett and the city of Cœur d'Alene, Idaho.

CONSTRUCTION PROJECTS

Pacific Gas & Electric Company, San Francisco, Calif., plans transmission line in Big Valley district, Siskiyou County, about 22 miles, to cost $60,000. State Teachers' College, San Francisco, Calif., plans laboratory unit addition to cost $130,000. National Motor Inns, Rialto Building, San Francisco, has plans under way for six automobile service, repair and garage buildings in different California cities, entire project to cost over $500,000. Tacoma, Wash., contemplates extensions in underground conduit system for city lighting to cost over $200,000.

SOUTHWEST

—NO VERY LARGE CONTRACTS *have been reported closed during the past week in the St. Louis district. However, the volume of orders for smaller sizes of apparatus has held up to the average of September.*

Business from industrials has been below normal on account of the absence of building. The following orders have been placed: A bank of transformers for the western part of this district to cost $20,000; a small white-way job $3,000 and three lots of motors for local concerns aggregating $4,500.

CONSTRUCTION PROJECTS

Union Electric Light & Power Company, St. Louis, Mo., has plans under way for steel tower transmission line from Osage hydro-electric power plant, Central Missouri to St. Louis, to cost $1,000,000. Fleming-Wilson Mercantile Company, Topeka, Kan., has plans for plant to cost $100,000. Arkansas Power & Light Company, Little Rock, Ark., plans extensions and improvements in Woodward substation, and additions to transmission lines, to cost $300,000.

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MIDDLE WEST

—THE GENERAL OUTLOOK *for business in the Middle West section this week appears more promising. While the volume of business has not increased to any large extent, certain indications seem to point to better business next month despite the current wave of wage reductions. The consensus of opinion seems to be that this action will furnish business with its much-needed stimulation.*

The major industries are in a somewhat improved position, with some increases in awards of heavy steel noted and rumors of anticipated increases in production in the automotive industry next month. One of the most encouraging items of interest this week is the reported buying among the railroads of equipment and rails, even though to a limited extent. Although general carloadings remain about the same, one carrier reported an increase in revenue cars handled this week. Industrial activity continues spotty, although some seasonal activity is becoming evident.

CONSTRUCTION PROJECTS

Consolidated Water, Power & Paper Company, Wisconsin Rapids, Wis., has plans for pulp bleaching plant at mill at Appleton, Wis., reported to cost over $60,000. Kohler Aviation Corporation, Grand Rapids, Mich., plans aircraft hangars at local airport to cost over $150,000. Petoskey Electric Light Plant, Petoskey. Mich., contemplates hydro-electric power plant on site recently ac-

quired on Bear River to cost $100,000. University of Akron, Akron, Ohio, has plans for new Guggenheim Aeronautical Research Institute to cost $100,000. Sioux City Gas & Electric Company, Sioux City, Iowa, will carry out expansion and improvement program at steam-operated electric power plant, including installation of generating unit, to cost $600,000.

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EASTERN

—FAVORABLE FACTORS CONTINUE *to give encouragement in the electrical equipment market in the Eastern district, and that certain optimism is justified is indicated by a fairly well-distributed volume of current business. Future prospects, likewise, have a material bearing, and with central stations and industrials moving upward in connection with inquiries, October account opens up with an improved outlook.*

—GOVERNMENT BUSINESS *is an important feature of immediate transactions and the extent of bidding in that quarter indicates the keenness of electrical equipment manufacturers to secure commitments. Domestic electric apparatus is showing more signs of life with the advent of the fall season. Demand for street-lighting equipment gives good promise in the early weeks ahead.*

McIntosh-Seymour Corporation is low bidder at $89,966 for a Diesel engine-electric propelling plant for the Navy Department at Boston. Troy Engine & Machine Company has secured a contract for a steam-driven generator for the United States Army at Galveston, Tex. General Electric Company will furnish a bank of twenty large transformers and accessory equipment for the Commonwealth Edison Company and its subsidiary, the Superpower Company, award totaling more than $1,000,000. The same manufacturer has taken an order for a turbogenerator unit for a municipal power installation in Nebraska, at $47,000; the condenser will be furnished by the C. H. Wheeler Company.

Several iron and steel mills in the Pittsburgh district are placing contracts for heavy machinery and orders for electric-propelling equipment are expected to be placed at an early date. Textile mill account is showing up better and motors with control apparatus are expected to be in early call.

A contractor for a street-lighting installation in Westchester County has placed an order with a New York manufacturer for fixtures, cables, etc., to the sum of $45,000. Collier Construction Company, Cleveland, Ohio, is the successful bidder for a street- and park-lighting system at Washington, D. C., at a price of $86,452. Pennsylvania Railroad Company continues in the market for requirements for its electrification program and has placed an order with the Lima Locomotive Works for 30 electric locomotives and with Westinghouse Electric & Manufacturing Company for twenty locomotives.

CONSTRUCTION PROJECTS

Signal Supply Officer, Signal Corps, United States Army, Army Base, Brooklyn, N. Y., will receive bids until October 6 for resistors, carbon brushes, field coils, rectifier bulbs and other supplies (Circular 28); also, at same time for 12,000 ft. of cable and cable reels (Circular 31). Board of Education, New York, has authorized plans for high school with vocational department in Brooklyn, to cost over $3,000,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until October 13 for amplifying and control equipments, five transmitting station equipments, etc. (Schedule 6594). Gulf Refining Company, Pittsburgh, Pa., plans addition to oil refinery at Toledo, Ohio, to cost $1,000,000. Pittsburgh Steel Company, Pittsburgh, Pa., will build addition to mill at Allenport, Pa., reported to cost $750,000. Corps Area Engineer, 311 St. Paul Place, Baltimore, Md., will receive bids until October 19 for two rigid steel searchlight towers for Fort Monroe, Va. (Circular 4). Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until October 6 for main motors and control equipment (Schedule 6462).

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SOUTHEAST

—PURCHASES ONLY FOR CURRENT *requirements and those on a very conservative basis seem to be the rule in the Southeast and the outlook for the fall months holds little promise for any appreciable pick-up. However, the first cool weather has served to stimulate retail trade somewhat.*

A Georgia company ordered oil circuit breaker equipment amounting to approximately $5,800, meters totaling $2,660 and creosoted pine poles aggregating $2,600. The city of Jacksonville ordered recently one carload of power cable and a textile mill in Georgia purchased power transformers costing in the neighborhood of $4,000. Electrical appliance lines are reasonably active and may be said to be satisfactory when general conditions are considered.

CONSTRUCTION PROJECTS

Suffolk Peanut Company, Suffolk, Va., plans improvements to cost over $100,000. Kentucky & West Virginia Power Company, Ashland, Ky., will install ornamental lighting system on Winchester Avenue and other streets. Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids until October 7 for addition to hangar at Naval Reserve aviation base, Miami, Fla. (Specification 6674.)

NEW ENGLAND

—AN INCREASE IN INQUIRIES *for small power equipment is reported by a number of manufacturers, but sales show little tendency to move forward. During the past week one manufacturer showed a gain in small motor sales and reports that inquiries for single motors and control from small plants operating at increased capacity are gaining.*

Heavy electrical machinery is quiet and little demand for central-station supplies is reported, though one prominent firm of engineers recently announced receiving an order for the planning and construction of a transmission line for the Middle West which will cost about $1,000,000. On the other hand, municipalities are active in extending street-lighting service and one Eastern town has recently placed orders for 1,000 new lamps, while a southern Connecticut city plans to extend service along similar lines. Industrial electric heating is active and heating furnaces attracted much interest at the recent National Metal Congress and Exposition at Boston, one manufacturer reporting sales of two furnaces for a prominent wire company.

CONSTRUCTION PROJECTS

Massachusetts National Guard, Air Corps, Boston, Mass., has authorized immediate call for bids for hangar, shop and other units at Boston municipal airport, to cost $250,000. Yale University, New Haven, Conn., plans group of new buildings during next twelve months to cost $20,000,000. Connecticut Light & Power Company, Hartford, Conn., has plans for equipment storage and distributing plant at Meriden, Conn., to cost $135,000.

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Canadians Use More Electrical Appliances

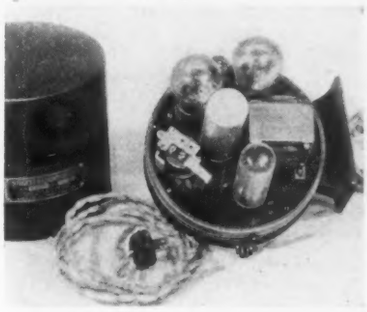
IN ITS REPORT for last year the Ontario Hydro-Electric Power Commission calls attention to the increase in applications for approval of electric appliances during that year, according to a report received by the Department of Commerce from Trade Commissioner L. A. France at Toronto. Although Underwriters' Laboratories have considerable weight with the commission, certain equipment must have the additional approval of that body.

During the year ended October 31, 1930, applications for appliance approval increased 38 per cent over the previous year, about 28 per cent of the applications being for heaters, 26 per cent for motor-operated devices, 17 per cent for wiring devices, sockets and switches, 16 per cent for radio devices and musical instruments and 13 per cent for lighting devices.

New Equipment Available

Light Sensitive Cell Operates Relays Direct

WHAT APPEARS TO BE a new conception of light control possibilities is announced in the Burgess "Radiovisor" bridge. It consists of a tall, tubular glass bulb with a three-prong base. Inside the bulb is a flat plate occupying the center and supported by two heavy lead-in wires. The plate is of



glass and on the front side are two interlocking comb-like grids or electrodes of gold, fused in place. These grids or electrodes are covered with a thin enamel of special composition the conductivity of which changes with the amount of light falling on it, thereby providing a light-sensitive cell.

Due to the appreciable amount of current that can be passed through the bridge, it becomes possible to utilize simple, practical and quite inexpensive circuits with this bridge, thereby multiplying many-fold the possibilities of light control. The bridge can operate a relay direct, for controlling a circuit handling a few watts of electrical energy, while a second relay provided with a novel form of vacuum contact permits handling several hundred watts for serious work. For more intricate applications vacuum tubes can be employed, in which event considerably less amplification is required due to the higher initial current available. Complete, ready-to-use light relay and light source units are available.

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A TOTALLY INCLOSED FAN-COOLED SQUIRREL-CAGE MOTOR for use in explosive atmospheres has been announced by the Westinghouse Electric & Manufacturing Company. It has been designed in accordance with and to meet the latest specifications of the National Board of Fire Underwriters for use in Class 1, Group D, hazardous locations. Free passage of cooling air is assured because of larger air passages and large spaces between guard and the non-sparking aluminum alloy fan. Air inside the motor is kept in constant circulation by fan blades on each end of the rotor.

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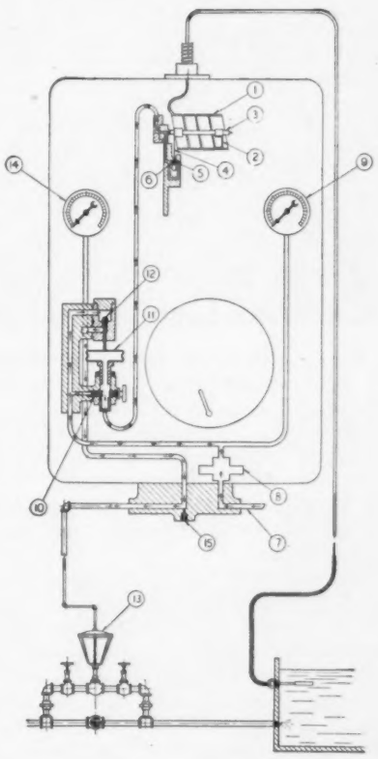
Air-Operated Recording Controllers

A LINE OF AIR-OPERATED recording controllers employing a "free vane" as the initiator of control has been announced by the Bristol Company, Waterbury, Conn. The "free vane" is attached to and actuated by a measuring element of a temperature or pressure recording system and moves between two air jets with stream lines coinciding placed opposite each other. In passing into these air streams the "free vane" varies the amount of air which escapes from the jets, thus effecting control.

The arrangement and design of the two jets and the "free vane" are such that the vane floats between two equal air streams at right angles to its mo-



tion, hence the position and movement of the measuring elements are not affected. The recording device is, therefore, free to reproduce the temperature or pressure accurately.

The component parts are easily accessible, although compactly assembled. The point of control is easily set to a visible scale point by means of a key.

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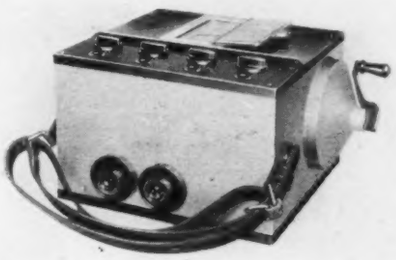
Varley Loop "Bridge-Meg"

IN ORDER TO PROVIDE as nearly as possible a complete portable resistance-testing outfit under one roof, the James G. Biddle Company, Philadelphia, offers what is called the Varley loop "bridge-meg" resistance tester. It is only 6½ in. high and weighs 13 lb. and performs three distinct services for electrical engineers and maintenance men, viz: "Megger" tests of insulation



resistance from 10,000 ohms up to 100 megohms; Wheatstone bridge tests of conductor resistance from 0.01 ohm to 999,900 ohms, and Varley loop tests for locating faults on conductors, such as telephone, telegraph and signal wires.

There is built into the set a d.c. hand generator that supplies current at 500 volts for "Megger" tests and at 250 volts for Wheatstone bridge and Varley loop tests. It is suggested that this combination instrument will find a valuable application among engineers and electricians who need facilities for making accurate measurements of conductor resistance and a means of locating faults, where the line resistances are sufficiently high.

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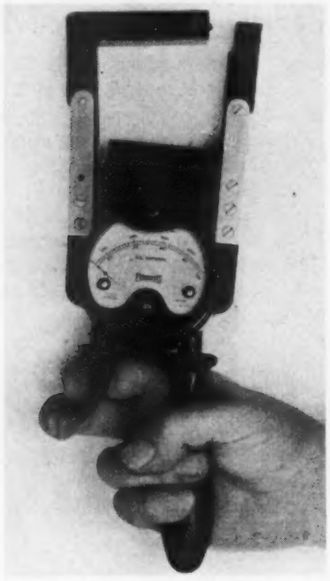
A NEW TYPE OF ELECTRIC HAND DRILL, which bores with equal facility into wood, metal and masonry, and is known as the Wodack "Do-All" twist and hammer drill, has been announced by the Wodack Electric Tool Corporation, Chicago. The tool requires only one minute to drill a $\frac{5}{16}$-in. hole 3 in. deep in concrete, it is claimed. In addition to operating as a hammer, it may be used as a rotary drill with correct speed and power to provide maximum drilling efficiency over the entire range of sizes from 0 to $\frac{3}{8}$ in. in metal and $\frac{1}{2}$ in. in wood. It is also an effective tool for grinding, scratching or buffing, the manufacturer states. It permits the operator to sharpen tools and bits right on the job.

Clip-on Ammeter

AN INSTRUMENT KNOWN as the clip-on ammeter announced by Ferranti, Inc., should be valuable to electrical superintendents for determining the actual loading of transformers, for balancing



secondary transformer loads on three-wire services or for checking power consumers' loads. It should also be of value to electrical contractors and plant electricians in determining actual loads taken by individual motors, or balancing loads on different circuits or feeders. It consists of a split-core current transformer with the secondary connected to a high-grade Ferranti milliammeter calibrated for direct reading in amperes.

This instrument affords a rapid and convenient method of measuring the current in any a.c. leads or busbars without disconnecting them for the insertion of the usual current transformer or ammeter leads. The meter has a double range, one scale being 0-100 amp. and the other 0-500 amp. A switch on the meter changes the reading from one scale to the other.

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Oil Super-Purification Self-Contained Unit

A NEW FORM OF OIL super-purification equipment, which not only removes the solids and free water but air, gases, kerosene and water of solution, as well as other light volatile contaminents, has been placed on the market by the Buckeye Laboratories, Inc., Alliance, Ohio. The unit is self-contained and may be operated by inexperienced operators, inasmuch as it requires no adjustments or dismantling and reassembly for cleaning.

Many new features are incorporated, such as full low density heating of the oil to prevent oxidation, full automatic pressure, temperature control, heat exchanger for cooling the oil before discharging to tanks, thus preventing sweating of the oil, as well as a vacuum drying chamber for drying the filter paper blotters.

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Series Lighting Protection

A PROTECTIVE SHORT-CIRCUITING DEVICE which, supplemental to the regular construction, may be built into the base of "Mazda" incandescent lamps designed for burning on series circuits has been announced by the Westinghouse Lamp Company. This device is to be known as the "inbuilt cutout." In addition to the greater convenience of relamping after burnout, it serves as a completely reliable means for quenching the arc, which, upon burnout of the filament, has occasionally persisted.

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End Seal for Outdoor Cable

A NEW TYPE OF OUTDOOR CABLE end seal for single-conductor, lead-covered cable has been announced by the G & W Electric Specialty Company, Chicago. This new pothead consists of three main parts, the flanged lug into which the conductor is sweated, the wiping sleeve and a porcelain bushing. The flanged fittings are securely clamped against the gasketed ends of the porcelain by means of hook belts. This device is for 600-volt, 1,000,000-circ.mil cable.

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Electric Steam Generator Unit

A LINE OF ELECTRIC steam generators for application anywhere in the industry where steam is needed, but is not available in sufficient quantities or at suitable pressure, has been announced by the General Electric Company. The line includes two pressure ratings, 100 and 200 lb., in various sizes and electrical ratings.

The standard unit consists of a suitable steel container in which one or more helicoil sheath-wire immersion heaters are inserted. The generator is provided with standard boiler fittings, including a safety valve, steam gage, water column, blow valve, steam valve, etc.

Some of the applications for this equipment are atomizing oil for oil burners, vulcanizers, coil-forming presses, dental vulcanizers, curing celluloid products, etc.

Copper Ground Rod Has Steel Core

A NEW COPPER GROUND ROD with heavy copper exterior, securely bonded to a rigid steel core, has been announced by the Bridgeport Brass Company. The copper is applied uniformly to the steel by a method developed by the manufacturer. It will not fold, slip, wrinkle nor pull loose during driving, it is claimed, and it defies the moisture and corrosive action of the soil, so destructive to the ordinary galvanized steel rod. The point of the rod is designed for easy driving and a good copper-to-earth contact exists at all times after driving. This, with a copper-to-copper contact between the rod and the ground wire, means a ground resistance as low as the earth itself will provide. The rods are available in standard sizes.

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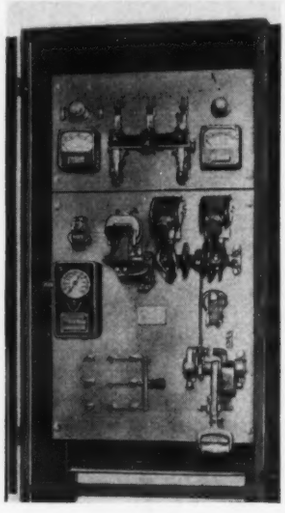
Motor Starters for Fire Pump Service

A COMPLETE NEW LINE of a.c. and d.c. manual and combined manual and automatic motor starters for fire pump service is announced by Cutler-Hammer, Inc., Milwaukee, Wis. This line includes a type of starter for every application of fire pump equipment. A new, modern design, dust-proof and splash-proof, floor type inclosure protects the mechanism and adds materially to the appearance of the instal-



lation. This inclosure consists of a heavy angle-iron-supporting frame with sheet-metal inclosing panels and doors at the front.

Some of the other features of this line include double-throw main line knife switch for two sources of power supply, low-voltage protection, circuit breaker overload protection, carbon-to-copper current-carrying contacts, etc.